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AGRICULTURAL JOURNAL

ISSUED QUARTERLY BY THE

DEPARTMENT OF AGRICULTURE, FIJI.

VOL. 4.] FOURTH QUARTER, 1931. [NO. 4.

EDITORIAL.

THE present issue completes the volume of the *Journal* for the year 1931. The financial provision in 1932 will only permit the publication of two issues, so that readers are requested to note that the 1932 volume will consist of two copies. An endeavour will be made to circulate information to agriculturists in Fiji by means of multigraphed notes.

Fiji Show and Agricultural Conference.—A comprehensive exhibit was staged by the Department on the occasion of the Fiji Show in October and attracted wide attention. Cinematograph films on agricultural subjects, loaned by the Imperial Institute, London, were displayed in the Health Department section of the Show by courtesy of the Health Exhibit Committee. It is interesting to record that the Show as a whole was very successful. The Fiji Show Association are to be congratulated on their decision to hold this function in spite of the difficult local conditions. It is noteworthy that in spite of the fact that there were no stock exhibits, the number of entries in all classes exceeded that of 1930. It is understood that the financial result is entirely satisfactory.

The Agricultural Conference was opened on October 13th by His Excellency the Governor. Meetings were well attended and keen interest was displayed in the subjects dealt with. A full report of the proceedings will be found in this number.

The Convention of Agricultural Associations was duly formed at an inaugural meeting of delegates on Tuesday, October 27th, 1931, when five out of the seven participating Associations were represented. The affairs of the Convention will be managed by an Executive Committee consisting of the Hon. Sir J. M. Hedstrom, the Hon. Alport Barker, E. Duncan, Esq., J. L. Hunt, Esq., and the Director of Agriculture. The Director of Agriculture was elected President of the Convention. His Excellency the Governor has been pleased to accord recognition to the Convention.

Fruit exports.—The output of bananas is rapidly increasing and in November 14,181 cases were shipped; 16,266 cases were exported during the period December 1st to 16th. The general improvement in quality has been maintained and this, with the more extended use of better cases, renders shipments more attractive than hitherto. Trials are in progress

with a new type of case which while actually of smaller over-all cubic measurement contains the same, or a slightly greater quantity than the standard case at present used. A noteworthy feature of banana production is the increasing quantity now being shipped from outside districts such as Taveuni, Savusavu, Koro, Gau, Moala and Kadavu. The re-establishment of the banana industry in the Sigatoka Valley is proceeding and arrangements have been made to meet the cost of the suckers required by an advance from Government, the repayment of which is guaranteed from Provincial Funds. Similarly, in the Rewa River districts suckers will be provided for those who require them and payment made from the proceeds of the crop. Although the wider area over which the banana-growing industry is now spread renders transport and control of quality more difficult, there is the undoubted advantage that in the event of localised severe storms the output will not be affected to nearly so great an extent as was the case when the production was almost entirely confined to the Rewa River basin.

Referring to the subject of citrus exports which was discussed in *Journal* No. 2 of 1931, it is interesting to observe that Cyprus intends to explore the possibilities of exporting citrus fruits to New Zealand. In the *Cyprus Agricultural Journal* of September, 1931, reference is made to the substantial preference of about 7s. 4d. a case placed by New Zealand on oranges from Empire sources. The fact that a Dependency so far away from New Zealand as Cyprus is should be seriously considering the marketing of fruit in New Zealand should provide a stimulus to growers in Fiji, who are exceptionally favourably situated for that market. The Cyprus authorities are fully aware of the difficulties attending transport for so great a distance and they also have in mind the safeguards enforced by New Zealand against the introduction of fruit-fly. Now that it is known that the fruit-fly can be killed by exposing fruit to a low temperature, there is some prospect of easing the existing regulations. The Department of Agriculture, Cyprus, is apparently in communication with the New Zealand authorities on this subject.

FIJI AGRICULTURAL CONFERENCE.

October 13th and 14th, 1931.

Mr. Barnes, in introducing His Excellency the Governor, said that this was the third occasion on which the Agricultural Conference had been held and that there were a number of interesting papers for discussion, including one new subject which had not hitherto been touched upon. He informed the gathering that last year the Organising Committee had been authorised to carry on its work with the object of endeavouring to form a Convention of Agricultural Associations, a central union as it were of country bodies, which could speak with authority on matters of agricultural interest, and a body which could be regarded by the Government as the channel through which matters of such interest could pass to and from the country districts. Mr. Barnes informed the Conference that the Committee had considered very carefully the requirements of such a body and formulated a draft set of rules which had been circulated, together with an explanatory letter, to the Organisations, both in Suva and the country districts. He intimated that the response had been most gratifying, seven of the Agricultural and similar Associations of the Colony had expressed a desire to become members of the Central Association. Continuing, Mr. Barnes remarked that this Conference would not deal with the work of the Central Association, but would be, as it were, an educational institution which afforded an opportunity of getting together to discuss matters of common interest. He said that His Excellency the Governor had taken a very keen interest in matters of this kind ever since his arrival in the Colony and that his presence to-day showed his continued interest in the objects for which the Conference had been called.

His Excellency, in rising to open the Conference, said that it gave him great pleasure to welcome on behalf of the Government those who had come to the Conference, and in particular those who had come from districts outside Suva. He said he would take the opportunity of thanking the Mayor for so kindly placing the Town Hall at disposal. He remarked that in particular he referred to the people who had come from outside Suva because he regarded it of the greatest importance in a Colony such as this where the Islands were so scattered and communication so difficult, that the people should get together for the discussion of common problems. Agriculture was the essential life of the Colony and therefore it was most important that the agricultural community should meet to consider matters which were continually before them. He remarked that the present day production questions had become extremely acute, and it was essential that the people should improve their methods if they were to market their produce in a better manner. He felt convinced that Fiji could do a lot more in that line and if the people were to do that more they were bound to get a favourable market. He said Fiji had the soil and the climate, and what were wanted were men who were willing to get down to hard work. His Excellency went on to say that the agricultural community must work together to get their goods on the market. He remarked that he had spoken before about Government assistance in planting and grading, and he hoped that the planting community would co-operate in connection with these matters. He did not suppose that Fiji could work up to a high reputation for its produce quickly, but if we could put oranges and other produce on the market with a Govern-

ment guarantee behind them they were bound to find a good market. His Excellency remarked that copra was a product in which he had taken a very keen interest during the last year. He said he had been round the Western Pacific and had examined the copra produced and on his return had called in at Rotuma. He informed the Conference that steps had been taken in the Gilbert and Ellice Islands Colony definitely to prohibit the export of inferior copra. When he went to Rotuma last year he saw the worst copra which he had ever seen. He did not think that such bad copra could be made. Government had taken steps with the full co-operation of the people and the storekeepers, and had sent a Coconut Inspector for the special purpose of helping the people to produce a commodity of better quality. When he called at the Island this year he was astonished to see the extraordinary improvement brought about. His Excellency said that if the people of Fiji worked to a standard of the best and kept at that standard the produce would find a very much better market than it had at present. He remarked that the question of the grading of copra had been under consideration by the Government and that he was now awaiting a report from the Coconut Committee to whom he had referred the grading proposals. He noticed that there were two very interesting papers on the banana question on the Agenda of the Conference. During his visit to the Agricultural Show he had observed two banana cases. One cost less than 2d. more than the other, it was nicely planed and was a much better looking case. In the same way the packing of citrus fruits could be improved and more care taken in the preparation of the fruit for the market. He assumed the planting community that the Government would do all in its power to assist them. He thought that the Colony got very full value for the money which had been spent by the Agricultural Department. He regretted that the Government was unable to make a larger sum available for the extension of Experimental Stations to investigate the growing of plant material, pure line seed, &c. In this connection he wished to express the Government's thanks to Mr. Duncan who had very generously put at the disposal of the Government some land in Bua for the purpose of experimental work, but he was afraid that the present finances would not permit of any definite extension. Mr. Duncan's offer would be kept in view and he hoped that before long something would be accomplished in this direction. In conclusion His Excellency said that he hoped the points he had raised would be brought out during the discussions of the Conference.

Mr. Hunt read his paper " Banana Growing in Fiji " as follows:—

Banana growing in Fiji for some years past has not been considered as a planting proposition by Europeans. The duty imposed by Australia and the lack of good distribution at other markets caused the industry to dwindle to a notable extent.

Planters did not feel inclined to stand up to the extra expenditure of combating the borer and other pests when marketing facilities and distribution were not available so the wastage on European plantations was very great.

It would be well to call attention to the fluctuations which the banana industry has undergone since its inception. The first record dates back to 1877 when 3,100 bunches were exported. Eight years later this number had risen to 277,973 with a further rise by 1890 to 371,417. In 1892 the number was doubled, 799,210 bunches being exported and for many years this constituted a record. In 1893 the output had dropped to half and by 1895 had reached the low water mark of 155,474 bunches.

From this point a rise with fluctuations set in:—

1897	272,338	bunches.
1900	488,690	,,
1902	424,993	,,
1905	313,829	,,
1910	433,524	,,
1911	1,328,670	,,
1917	1,653,639	,,

which was the largest amount ever shipped from the Colony. In 1918 the quantity fell to 939,974, in 1919 to 520,038 and by 1930 to 165,000, almost as low as the record year of 1895. Duty to Australia was increased from 2s. to 8s. per case in 1921.

Although the importance to Fiji of the banana industry has suffered a severe set back by reason of the prohibitive duty involved on that fruit imported into Australia, the latent possibilities of these Islands in trade expansion for bananas and citrus fruits are such that it is difficult to estimate to what extent it will benefit the Colony when it comes into its own again.

Indications of a revival in the near future are bright. Since the hurricane and floods of 1929 and 1930 have swept Fiji, bananas are showing great promise and coconut planters who have been hard hit by low prices for copra are now planting bananas to a large extent and many others are seeking information as to planting, cultivation, pruning, powdering, cropping, &c., of this most valuable crop so the following may supply the information required.

There is no doubt the wet zone of Fiji is the most suitable for banana production. Planting distances are regulated by the quality of the soil. On rich banana land the distance for the Cavendish variety is 10 ft. by 10 ft. equal to 435 plants to the acre—a suitable distance, even 9 ft. by 9 ft. or less if it is not intended to replant the area: 10 ft. by 10 ft. and 9 ft. by 9 ft. allows of efficient working by implements.

For the tall varieties Veimama and Gros Michel 11 ft. by 11 ft., 12 ft. by 12 ft. and 14 ft. by 14 ft. (according to soil and intention of ultimate use of this soil) between rows allows of the interplanting of permanent trees such as coconuts, citrus fruits or tung oil which remain and reach the productive stage after the banana plantation has produced four to five years crops.

When good land has been well ploughed and cultivated or virgin bush felled and cleared, line out to the distance decided upon, dig holes 18 in. by 18 in. by 12 in. deep, even larger in virgin land and set the banana sucker or bulb on loose top soil in bottom of hole and fill up same to within three or four inches of the top. The filling of the hole to surface level does not take place until the stool is well and truly established and cultivation between the rows both ways has ceased.

The banana is a surface feeder and no matter how deep you plant the original bulb the stool always works upwards.

To plant deep to obtain better resistance against high winds does not materially assist as the stool gradually rises; but if planted in good friable soil the roots soon penetrate and the stool obtains a very solid grip.

Drainage must be good and efficient. Bananas can stand a heavy rainfall but not wet roots.

The best months to plant are August, September, October, and November. Care must be taken in the selection of plants. The sword or spike suckers are preferred, their leaves are just forming long and narrow and from 2 ft. to 3 ft. high with good bulb-like butts or corms. Examine carefully to see that they are clean and free from borer.

On a well conducted banana plantation nurseries are established yearly of sufficient extent to provide plants for whatever area has to be planted yearly. These nurseries should be planted out in January when selected plants and stock from them will be ready for planting out in the following August and onwards. In this way there is less risk of borer than there would be if plants are taken from old plantations.

It is advisable to dig out the whole stool from the nursery, divide up and discard any weak looking or leafy suckers and four plants at least should be available from each stool at 7 months old. It would be well to steep all plants before planting into nurseries as directed by Mr. Simmonds as one would then be certain of obtaining plants free of borer.

To obtain good bunches it is necessary to prune, that is remove certain shoots or followers from the parent plant, not by careless digging but by cutting them well under the surface without damaging the parent plant and unless special tools are used, stab the centre of the bulb or corm removed making a circular movement in doing so. An implement, the patented invention of Mr. Chave Morrison, somewhat similar to a small post digging auger was used here when bananas were plentiful and was an excellent tool for pruning purposes. It is unnecessary to prune till parent plant is six months old, or seven months old, unless growth has been excessive. Experience will teach you which suckers to remove. Weak suckers are distinguishable by their poor looks, slender, long and leafy. A good sucker or follower has a nice full round bulb at the butt and tapers to a sharp point before throwing leaves. The most to be left round parent plant would be three and those must be the best, both as regards position round the parent, and age as regards rotation of throwing bunches. Where growth of parent and followers is very strong it is sufficient in first pruning to leave only two followers.

It has been found very difficult in Fiji to prune so as to have stools fruiting when market prices are high, especially with Gros Michels as their natural months for carrying the flush of fruit are January, February and March, and this variety is liable to be killed out by pruning to get it to produce mature fruit in August and September. The Cavendish and Veimama, if properly pruned will carry fruit all the year round, but take longer to mature in the winter months; as the temperature rises, so does the crop improve. In the cool months a period of sixteen weeks elapses between the shooting of the "flower" to the time the bunch is cut, where in the height of summer that period is ten weeks only.

In 9 to 12 months' time under ordinary favourable conditions, the plants of the Cavendish variety are full grown and the flower shoots. Two and a half to three and a half months afterwards the bunch is ready to cut for shipment, three quarters full or slightly over that stage.

When the plantation has reached the bearing stage the flowers or "sobos" start to shoot and these have to be attended to immediately the flower leaves the vertical and is becoming pendant. The man who has charge of the cleaning and powdering must be expert at his work. He starts from the top and removes carefully the sheath covering each hand and keeps on working downwards till he comes to hands which would be too small when ready for market; below this he removes both sheath and hand for several hands and then leaves the balance at end of stalk or stem.

The bunch is then efficiently powdered with insecticide blown in all over the hands and between the fingers to keep off insects, thrips and other pests that immediately attack the bunch.

This cleaning and powdering must be carefully and efficiently done otherwise the whole crop might be ruined, and having brought a plantation

to the bearing stage it is well to see that not a bunch is lost so that the maximum return is obtained. The insecticide is one part Pryethrum Roseum and three parts of selected white sifted wood ashes carefully mixed together.

Too much of this mixture should not be made up at a time. Mix only sufficient to do one or two days' work and keep in a closed tin after mixing. It is well on the next day again to look over the flowers or bunches, especially in wet weather. There are many men in Fiji that are quite expert at this work and can efficiently clean up to 120 flowers per day, but it is not advisable to give a cleaner piecework.

The cost of bringing an acre of bananas into bearing without counting the proportionate cost of the planter's house or his upkeep during the period, that is, from the time of clearing the ground and planting till the crop is reaped is £13 to £18 per acre according to the country operated on.

In Fiji the first or plant crop will come into bearing on good soil in 12 months. Marketable bunches have nine hands or over and where the fruit is shipped on the stalk, bunches under nine hands are broken up into hands or fingers as the market requires and the fruit is shipped in cases; the 3-feet double case for New Zealand and the bushel case for the Commonwealth of Australia.

A 3-feet case properly packed in single fingers contains from 80 to 85 lb weight of fruit, and a bushel case if the hands packed therein are not too large, about the same.

An acre of bananas on good soil and free from disease should produce within 15 or 16 months at least one bunch to a stool or plant set out. These figures are conservative but a blow might more or less seriously alter expectations.

The profitable life of a healthy plantation should run from one of plant crop and three or four years of ratoons and on a well organised plantation it is well to replant one-fourth or one-fifth every year so as to keep up regular output.

Under present methods of cultivation it is considered that one man can look after five acres, and one should expect to receive on the plantation from 1s. 6d. to 2s. 6d. per bunch and from 3s. to 5s. per case or even 6s.

The Australian market could absorb enormous quantities of bananas from Fiji if distribution were properly organised. The New Zealand market, although limited, is a growing one, but here again there is scope for large extension, provided transport and handling are cheap and distribution is widened and extended.

Another very large market to be explored is Canada, and the establishment of direct communication with Fiji would be an arrangement mutually beneficial to this Colony and to the Dominion and everything possible should be done to secure it.

To assist the industry it is vital and necessary that freight charges should be reasonable. The present charge of 4s. per case freight from Suva to Auckland will seriously cripple a reviving industry.

Mr. Simmonds read his paper "Pests and Diseases of the Banana in Fiji" as follows:—

Before proceeding to discuss the actual diseases attacking bananas in Fiji I would like to call your attention to the big fluctuations in output of this crop that have occurred since the fruit was first exported. Mr. Hunt has given figures showing how, starting with 3,100 bunches in 1877, the industry had expanded in 15 years to just on 800,000 and then in three more years

had fallen to the record low crop of 155,000 bunches. So far as I have been able to ascertain this sudden fall was brought about by two causes, a disastrous flood in the Rewa, followed by a severe outbreak of bunchy top in Tailevu.

2. In 1911 another big fluctuation occurred, when the quantity rose from 433,000 to 1,300,000, due to the opening up of large areas on the Rewa. Six years later, the record output of 1,653,000 bunches was reached, which fell, owing to the influenza outbreak, to under the million the following year. This was followed by the Australian strikes and then the duty, leading to the present low figure, and incidentally, to the disappearance, only temporarily it is hoped, of the European grower.

3. Whilst the duties imposed upon Fijian fruit by the Australian Government in 1921 destroyed any hope of the trade recovering the position it held in that market in 1917, the high quality of the bananas shipped from Fiji had won such a good name, that it seems probable that if this country is again able to supply bunch fruit of that grade, it should, despite the duty, be possible still to send a certain quantity profitably to that market.

4. I now propose to consider what were the factors which had put the European grower out of practice and placed the country in the position of being unable to supply either the quantity, or quality, formerly exported. Apart from the closing of the Australian market by a tariff, there is no doubt that irregular and infrequent shipping were the most serious individual difficulties that growers had to contend with. Unless growers have at least a two-weekly service they suffer serious losses due to fruit passing the shipping stage between boats. On the other hand, unless a certain quantity of fruit is available it does not pay shipping to call, so that, when production falls below a certain critical point, the grower has to face further losses due to insufficiently frequent shipping.

5. At the same time the speaker is of opinion that the main factor leading to the abandonment of cultivation by Europeans was the appearance of certain diseases, some undoubtedly introduced, while others first recorded in Fiji may have been of local origin. Of these diseases there are three that stand out prominently, the earliest to appear being bunchy top. This was followed by the introduction, at an unknown date, of the borer *Cosmopolites sordidus* and, about 1913, the obscure condition known as Sigatoka disease, made its appearance. Of these troubles the most universal and disastrous was, in the speaker's opinion, the borer and much of the trouble blamed to the last named disease was probably due, directly or indirectly to this insect. Now that a method has been evolved of dealing with the borer pest it appears that there is again an opening for the European grower and by the use of the careful methods possible under estate conditions, a possibility of not only increasing our present shipments to the New Zealand market, but of also obtaining a profitable return for a percentage of our highest grade fruit in the Australian and Canadian fields.

6. I will now review the diseases of the plant in Fiji, particularly those which have contributed so seriously in bringing about the present low output and describe some experiments carried out by the Department which encourage the hope that the time has now come when it should again be profitable to take up the planting of this crop. It will be noticed that low as the output of 1930 was, it was not so low as that of 1895, only three years after the big export of 800,000 cases. That was, as stated earlier, due to bunchy top and the recovery from that disaster is encouragement that Fiji bananas may again recover from the cumulative effects of borer, Sigatoka disease and shipping troubles.

BUNCHY TOP.

7. This is the oldest disease of bananas in Fiji and, at the time of its appearance, had not been recorded from elsewhere. It reached its maximum about 1894–5, but had been present probably since as far back as 1885. In 1913 the disease appeared in Queensland, it is said having been imported from this country. It was undoubtedly taken from Fiji to Wallis Island and more recently has been reported from Ceylon. Whether the Ceylon disease is identical is as yet uncertain.

8. The origin of the disease in Fiji is very obscure. It has been suggested that it was originally a sugar cane disease which, in Fiji, moved over to bananas. There is, however, no evidence to support this suggestion. A more probable suggestion is that it was imported with an immune strain of suckers about 1885 and then rapidly spread through the non-immune plants. Such importations are known to have taken place about that date from Tanna and elsewhere.

9. *Symptoms.*—The disease is characterised by rosetting or proliferation of the foliage. The leaves become small, erect, brittle and dark in colour and in well-marked cases the plant produces no fruit.

10. *Cause.*—The causal organism is unknown, but the disease, which belongs to the class known as "virus diseases" has been proved to be transmitted from plant to plant through the agency of an aphis, *Pentalonia* sp. Whilst this is the only insect at present known to be capable of spreading the disease it is possible that other sucking insects, such as *Lyricen* sp. may be proved able to do so. The aphis is not easily found as it generally lives inside the bases of the leaves and similar sheltered situations. Its control by any method of spraying is thus rendered very difficult.

11. *Bunchy top control.*—At the present time bunchy top in Fiji cannot be said to cause very great losses, and the plants seem to possess a considerable degree of resistance or immunity.* Growers are advised to destroy immediately any plant observed to be affected. Before doing this a small quantity of kerosene or kerosene emulsion should be poured into the heart of the plant to kill as many aphis as possible, thus prevent their flying to other plants, and so spreading the disease, and then to dig up the whole and burn it, or dump it out to sea.

NEMATODES.

12. Banana roots in the old experimental station at Nasinu and elsewhere have been found to suffer severely from a species of nematode worm, *Tylenchus* sp. Attacks by this worm lead to a good deal of rot in the small rootlets, allow the introduction of fungi and have been connected with the so-called Sigatoka disease.

BANANA SCAB MOTH (*Nacoleia octosema.*)

13. The larvæ of this moth cause the unsightly scabs often observed upon bananas in this country. The insect is also known from Java, Queensland and Samoa.

14. *Life history.—Egg.*—The eggs are laid in small clusters on the back of the small leaf which encloses the shooting spike or on the surface or base of one of the surrounding leaves. They are extremely flattened and very minute, so that a cluster of 9 or 10 eggs has the appearance of a light brown scale, perhaps $\frac{1}{8}$ inch across. The eggs are deposited about the time that the bunch is being thrown, seldom later. The incubation period is very short—about 72 hours—and the young larvæ will be found to have already entered the spike by the time that this has reached the horizontal position.

* It has been found that a small percentage (5–7 per cent.) of plants subjected to the soaking treatment for borer throw bunchy suckers from the eyes, suggesting that the disease is present but latent and that the severe shock of the treatment caused it to develope. XX, 6

They do this, not by boring in, but by entry at the tip, where the sheath is uncoiling. For this reason they generally reach the terminal hands first and, fortunately, the larger basal hands are less frequently attacked.

15. *Larva.*—The larva is a dirty pinkish caterpillar which feeds between the fingers, generally upon the outer surface, but frequently, when two-thirds grown entering the green fruit and hollowing it out. They make the fruit into a disgusting mess with accumulations of frass, and render it commercially useless, owing to the disfiguring scars where the larvæ have fed.

16. *The pupa.*—The larva spins a frail cocoon, generally between two fingers, within which it pupates. The pupa is light brown in colour and about § inch in length.

17. *The adult.*—The adult moth is pale dirty yellow in colour with a few black spots and lines. It is nocturnal in its habits.

18. *Natural enemies.*—In Fiji a single specimen of a Braconid parasite was once bred out of a larva by the speaker, whilst a pupal parasitism of 20 per cent. by a smoky winged Chalcid has been occasionally obtained.

19. Two parasites have been recorded from Queensland, both apparently casual. Some years ago also Leefmans bred a Braconid in Java, from the carva, but the speaker reared upwards of 500 of the moth from various Javanese sources and failed to recover it, so that, this also, is probably only a casual enemy of the pest. In Fiji egg clusters have been found which have been eaten, possibly by an earwig or ladybird.

20. *Artificial control.*—At present the only method of control known is to strip the bunch as early as possible of its bracts, open up the hands and fingers, blowing a mixture of pyrethrum powder and wood ashes (in the proportion of 1–3 in summer and 1–2 in winter) between the fingers. This method is only partially efficient, partly because a good deal of damage is already done before it is possible to clean the bunch and also owing to the difficulty of reaching all parts of the hands. The pyrethrum too is variable in quality and consequently in its action.

21. As the eggs are laid openly it is possible that in the future this may be found the most vulnerable point of attack. Egg parasites may be found; such, however, frequently have very slow powers of dispersal. It may, however, prove possible to train boys to search for the eggs and remove them before they have time to hatch until such time as experiments which are being carried out evolve a spray which will destroy those present and prevent further deposits. In this case all chances of damage to the fruit would be removed.

THRIPS.

22. There is in Fiji a small flower-haunting thrips which may cause a certain amount of corking of the surface of fruits. Its damage is, however, negligible.

FRECKLES.

23. There is in Hawaii a disease of the skin of bananas called freckles, which principally attacks the Cavendish variety. On Taveuni the speaker has seen a number of bunches of this variety showing a dense spotting rather recalling the disease freckles. It does not affect the quality, but only the appearance of the fruit and, up to the present, no work has, in this country, been done upon it.

SIGATOKA DISEASE.

24. The obscure condition known as Sigatoka disease was characterised by a tapering of the head of the plant and premature throwing of the fruit. The bunch was undersized, with small fruit, which ripened prematurely upon being cut. It first appeared in the Sigatoka district and about 1913 seems to have been present on the Rewa. Whether the condition still exists in

the Colony is uncertain, but none has been reported for the past three or four years.

25. Whilst there is little doubt that in a large number of cases what was called Sigatoka disease was really due to severe borer attack, the speaker did see in 1923, in the Sigatoka Valley, certain Gros Michel plants, tapering abruptly and throwing their bunches prematurely which, upon examination were found not to be suffering severely from borer or other maicroscopic disease. Like Panama disease, it was the Gros Michel which suffered most severely, the Cavendish showing some resistance from the first. With the almost total disappearance of the Gros Michel the condition seems to have died out and, at the present time, no complaints of premature ripening are being received.

SCALE (*Aspidiotus destructor.*)

26. When this pest first appeared in Fiji it was bananas which suffered most, subsequently, however, coconuts were more heavily attacked and the damage to bananas was not often great. It did, however, lead to compulsory fumigation of all export fruit for Australia, thus imposing additional expense upon shippers.

27. *Control.*—During the early ravages of the pest, and whilst it was still practically confined to bananas, control efforts took the form of spraying with lime sulphur, but with the spread of the insect to coconuts this ceased to be practicable and a number of natural enemies were imported by the Department of Agriculture in order to bring about biological control, very successful results being obtained.

28. In the course of this work six or seven internal parasites were introduced from Tahiti and Java and some six predatory ladybirds from Java and Trinidad. One of these *Cryptognatha nodiceps* from Trinidad has proved most highly efficient and generally speaking this scale causes little anxiety at the present time.

29. Several other scales have been reported from bananas in Fiji, none, however, have been found to be commercially important.

SMALL BANANA WEEVIL (*Polytus melber borgi.*)

30. This little weevil is almost an exact miniature of the banana borer *Cosmopolites sordidus*, to be discussed next, but is different in its habits, being generally found in the stem of the plant instead of the roots, whilst the early stages seem to be still unknown. In any case it is of no importance as a pest.

BANANA ROOT BORER (*Cosmopolites sordidus.*)

31. An Indian school master recently wrote to the speaker as follows: "The banana root borer is the worst pest of bananas known. Give the life history of the insect and a method of reducing its numbers in the plants." There is little doubt that this statement describes the position in Fiji and in the speaker's opinion, if the borer could be controlled, all the other banana troubles would sink to very minor proportions.

32. *Effect of borer.*—The borer affects the plant in various ways:—

(1) directly by reducing the size of the bunches. These instead of ranging from 10 to 12 hands fall to 6 or 8 only and such of inferior quality;

(2) also directly by shortening the life of the estate, reducing it so that at 2½ or 3 years it has the worn-out appearance expected in an old estate of a 5, 7 or even older cultivation.

33. There is also little doubt that it has an indirect effect, weakening the plant, causing it to fall over in high winds and allowing the introduction of fungus and other disease.

34. The pest is now widely distributed, being found in Java and through the Islands to New Guinea and Queensland, also in the West Indies, most of the Pacific Islands and Natal. Everywhere it has caused serious loss to planters and much thought has been given to methods for its control. Special entomologists have been working on it as a full-time job for some years.

35. *Life history.*—The white oval egg is laid in a groove in the corm of the plant at or just above the surface of the soil and is most difficult to detect. The resulting grub tunnels through the corm, occasionally, in young suckers, attacking the growing eye and causing the death of the plant. This tunnel gradually enlarges as the grub grows and is packed with the frass (excreta) of the grub. When full fed the larva makes its way towards the surface of the corm, but leaves a thin outer section, pupating without forming a cocoon. When, after 10 to 14 days, the adult beetle is ready to emerge it breaks through the thin outer section of the corm and so reaches the surface. It will thus be seen that during the greater portion of its life, the beetle lives within and protected by the corm with only the tiniest connection with the outer air. This renders any method of treatment most difficult, as in the very limited air circulation, no dip or fumigant can, at normal pressure, reach the grub except in a highly diluted condition. In view of this difficulty, efforts were first directed towards some biological method of control and, in 1913, the predatory beetle *Plaesius javanus* was successfully introduced from Java by Jepson. Although successfully introduced the beetle did not bring about any appreciable measure of relief and further work on the subject became necessary. From the end of 1926 up to 1929 a number of experiments were undertaken by the speaker which have been detailed elsewhere. These showed that:—

(1) whilst flight took place occasionally, it was so seldom that, as a factor in the spread of the pest, it was negligible;

(2) that the beetle crawled from one plant to another, but even this as a factor in the spread of the pest was not so rapid as usually thought to be the case, clean plants placed alongside heavily infected ones in several cases remaining clean at the end of 12 months.

36. This indicated that infection is almost always due to the presence of eggs or larvæ in the suckers used in establishing a new estate and if clean suckers could be obtained by some method of treatment, it should be possible to plant up land away from any old stools with confidence that the planter would reap a full harvest before the borer entered in sufficient numbers to do appreciable damage. Efforts have therefore been directed towards endeavouring to obtain a method of ensuring that the plants to be used in planting up should be clean, even though derived from infected sources.

37. First experiments were directed towards some fumigation method, carrying the fumigant (in this case carbon di-sulphide) into the borings by creating a vacuum and then releasing the poison. Whilst a considerable measure of success was attained by this method, there were some survivors even at the point when the plants were killed whilst it was doubtful if eggs would be hurt at all.

38. The next series of tests involved soaking the plants for varying periods and at various depths in cold water and by using the method detailed below it was found possible to obtain a full 100 per cent. mortality of borer without irreparable injury to the plant:—

(1) Good strong suckers must be selected, having one or more undeveloped lateral eyes in addition to the aerial stem.

(2) These suckers are placed in a tub, punt or other water-tight vessel, with the aerial stem upwards.
(3) They are then covered with fresh water to a depth of about two inches above the point where the stem joins the corm, leaving the aerial stem fully exposed to the air and light.
(4) They are left for 21 days, taking care that the water is maintained during the whole of that period at the same level. This is most important.
(5) After 21 days they are removed and planted out, either in an isolated nursery or in the field.
(6) It will then be found that they die back to the corm and one of the lateral eyes develops, producing, in 12 months, a bigger and better bunch than would have been the result had the sucker itself grown.

39. In conclusion a few remarks on the relative merits of the different commercial varieties of bananas may prove of interest as the question is often asked " What is the best variety of banana to grow ? "

40. There are only three commercial varieties in Fiji, viz., Gros Michel, Veimama and Cavendish. In the West Indies some attention has been given to another variety, Lacatan, and the notes on that fruit are from Wardlaw and McGuire's paper on " Cold Storage of Bananas."

GROS MICHEL.

Advantages.	*Disadvantages.*
Not easily damaged in packing.	Very subject to diseases, such as Sigatoka and Panama.
Favourite in America.	Slow coming into bearing.
Hands widely separated.	Liable to damage by hurricane.
Good colour.	Flavour of fruit second class.
	Difficult to clean bunches.

VEIMAMA.

Resistant to disease.	Fruit coarse.
Good carrying fruit.	Intermediate in coming into bearing.
Large bunches.	More liable to hurricane damage then Cavendish.

CAVENDISH.

Fruit superior, flavour first.	Fruit requires care in packing.
Early fruiting.	Hands close together, so liable to damage in cleaning.
Large number to acre.	
Disease resistant.	
Least liable to hurricane damage.	
Easy to clean bunches.	
Favourite in Great Britain, Australia and New Zealand.	
Good colour, but paler than Gros Michel.	

LACATAN.

Resistant to disease.	This fruit is not present in Fiji.
Good flavour, first grade, and texture.	Shallow rooting.
	Unsatisfactory ripening.
	Frequently poor colour.
	Very easily damaged.

41. It will thus be seen that in a Group like Fiji, subject to hurricanes, the Cavendish has very great advantages over the other commercial varieties, but the fruit requires more careful handling than either Gros Michel or Veimama.

Addenda.—Since this paper was written further work has been done and certain information on bunchy top come to hand, and it is considered advisable to add this now.

Origin of bunchy-top.—Whilst this disease was first recorded from Fiji, there is evidence to show that it was originally imported from elsewhere, probably on an immune strain. The earliest record I now have is 1886 on an estate close to Suva, following an importation of plants, it is thought from Tanna in the New Hebrides. It completely destroyed the estate in a very few months.

Banana Scab Moth (*Nacoleia octasema*).—Further work has shown that the egg clusters are placed, not only on the small leaf, but upon any of the leaves surrounding the shooting spike and on either surface or at the base, but only whilst the spike is being shot, so far as has at present been observed.

Mr. Witherow, in opening the discussion, said that both Mr. Hunt and Mr. Simmonds had read very interesting papers. Although both the above gentlemen had spoken so optimistically of the industry he was afraid that he must take a more pessimistic view. He said that he would touch on two aspects only—markets and shipping facilities. He remarked that at the present there was only one market to which Fiji could ship bananas and that was Auckland, New Zealand. This market was being supplied with fruit from Fiji, Samoa, Raratonga, the Cook Islands, Norfolk Island and Niue Island, and even Australia was shipping bananas to New Zealand. He understood that shortly there was going to be a direct service from Tonga to Auckland to carry fruit which was now being grown there. He said that if things had been normal in Fiji and we had shipped the usual 15,000 or 20,000 bunches of bananas monthly it would have been disastrous for the shippers. Even with the small shipments which had been made the losses had been serious. Mr. Witherow said that the time had arrived when we must look for another market and the only market that he could see available outside of New Zealand was the Canadian market. Canada, in his opinion, was an important market for all Fiji produce. Mr. Witherow remarked that some years ago a trial shipment of bananas was sent to Vancouver. They were shipped in cold storage and took 28 days on the voyage. Bunches realised an average of 15s. per bunch and the shippers received an excellent profit. His contention was that if bananas would carry for 28 days under such adverse conditions they should carry in good order and condition in proper ventilated ships. At the present time he said there was one ship, the "Tofua," carrying bananas to Auckland and he contended that she was unsuitable for the trade. The "Tofua" took about five days to do the trip to Auckland which should be done in about three days, and invariably arrived with a very large percentage of the fruit ripe or over-ripe which was a big loss to the shippers. He remarked that the "Tofua" had four boilers, but although representations had been made by the shippers personally and also by the Fiji Planters' Association that the fourth boiler should be used, the Union Company had refused to comply with this request, with the result that the fruit was at least 24 hours longer on the voyage than was necessary. He remarked that what was required was a well-ventilated ship running three-weekly services. The four-weekly service was far too long between shipments, especially during the hot months of the year, and resulted in a great loss to the native grower, who every trip picked a lot of immature fruit

because he knew that if the fruit stayed on the trees for another four weeks it would be useless. With a three-weekly service we could ship a good grade of fruit all the year round. Mr. Witherow remarked that Mr. Hunt in his paper had said that there were indications of a great revival in the banana industry. Mr. Witherow said that he could not see eye to eye with him unless a new market was found for the fruit. The New Zealand market was being overdone, shippers would not ship to New Zealand unless they could make a profit. Years ago when Fiji had an extra market in Australia for the fruit, Europeans had thousands of acres under bananas in Vitilevu. To-day he considered that he was quite safe in saying that there was not more than 50 acres under banana cultivation by Europeans. Mr. Witherow concluded by saying that there would be no big revival of the banana industry in spite of the excellent paper which had been read about the control of disease by Mr. Simmonds, until a fresh market had been found for the fruit.

Mr. Barker said that when he was in Vancouver he was taken by the Managing Director of a Cold Storage plant over the works and that there was lying at the wharf a British ship which had been used for carrying bananas from Brazil to London. The voyage took 16 days. Mr. Barker stated that his friend said Fiji bananas could be easily carried to Vancouver and his firm would be prepared to market the bananas not only in Vancouver but also in other places of Western Canada. The railway lines of the C.P.R. and C.N.R. ran to the cool storage rooms so that there would be no difficulty about transporting the bananas from there to any part of Western Canada. He remarked that he thought this should be taken up by the Government. Mr. Barker informed the Conference that this particular firm was willing to put on a shipping service, provided freights could be guaranteed.

Mr. Barnes said that the discussion on the papers had been very short, but very much to the point and that he was particularly interested in the matter raised by Mr. Barker as he had been exploring the possibilities of marketing Fiji produce in Canada. The speaker said that he did not share the pessimism expressed by Mr. Witherow. He had already said that new markets were wanted for Fiji produce and if the people were prepared to supply what was wanted at the price which the people could pay there would be no trouble in finding the markets. Mr. Barnes entirely agreed with Mr. Witherow that the banana shippers had had a thin time. Unfortunately the prices were fixed rather too high, which was a disadvantage from the shippers' point of view. It had been found necessary to call more frequent meetings of the Banana Licence Board which now met from month to month, and in this way was able to pay closer regard to the shippers' and producers' interests. The Fiji banana stood very high in the opinion of the people of New Zealand and they were always prepared to take Fiji bananas in preference to bananas from other places. Mr. Barnes called attention to Mr. Witherow's remark about the Auckland market being oversupplied. There were other towns in the North Island of New Zealand and even in the South Island which had not been touched as far as the marketing of Fiji bananas was concerned. A return of £7 or £8 nett profit per acre as quoted by Mr. Hunt he considered was sufficiently attractive to encourage more people to take up the cultivation of bananas. One important point which had been overlooked during the discussion was the development of a trade in dried bananas. He stated that inquiries had been received and he shortly hoped to make an announcement about this matter not only with regard to bananas but also the likelihood of marketing fresh pineapples.

Mr. Matthews drew attention to the fact that about twelve months ago in Auckland bananas were being retailed at 8d. to 1s. per dozen.

Major Willoughby Tottenham raised a point in connection with the railway freight on bananas in New Zealand. He said that he understood the Fiji bananas were charged at a much higher rate than New Zealand fruit railed from town to town.

Mr. Witherow said that he would like to supplement his remarks by stating that the freight on bananas to New Zealand was 4s. per case, a voyage of 1,200 miles. This freight worked out at about £4 per ton, which he thought was the dearest freight in the world.

Mr. Mander called attention to Mr. Witherow's remarks about the unsuitability of the "Tofua" for carrying bananas. He remarked that the "Tofua" had been carrying bananas for the last 20 years and from records in his office it was evident that the shipments arrived in Auckland in good condition. With regard to the freight on bananas Mr. Mander said that during the last ten months his Company had lost £12,000 on the running of the "Tofua."

Mr. Fernandez said that the information given about the freight on bananas from Fiji to Auckland was very interesting and quoted the fact that the Rewa Co-operative Dairy Company Limited paid 3s. 9d. per box freight on butter from Suva to Auckland, whereas from Auckland to London the freight was only 3s. 6d. He said that about eight or ten years ago the freight from Suva to Auckland was 1s. 10d. per case.

Mr. Hathaway spoke about the improvement of banana cases.

His Excellency said that all had listened with much interest to the papers of Mr. Hunt and Mr. Simmonds and the discussions had been very illuminating. He said that he was pleased to hear a little pessimism from Mr. Witherow which he was certain could be overcome. The question of new markets had been continually before the Government for sometime past and last year arrangements had been made for the Director of Agriculture to attend a Conference at Honolulu which was, however, postponed. Government would consider asking him to go further afield to investigate markets for Fiji produce. His Excellency mentioned Jamaica which had been properly organised and now had ships running to London with fruit. The Shipping Companies were passing through a particularly difficult time and they required our sympathy just as much as the planting community did. In conclusion His Excellency thanked Mr. Hunt and Mr. Simmonds for their very useful papers.

Mr. Turbet read his paper "The Stock Industry with reference to the Export of Beef" as follows:—

For many years the growing cattle industry of Fiji has lanquished for want of sufficient markets in which to dispose of our inevitable increase. The future development of our beef cattle raising industry is thus dependent on the establishment of an overseas market. There appear to be prospects of such a market in Hawaii, part of the territory of the United States of America and also on the mainland of the United States. With a view to sharing in this market an effort was made by a local breeder about two years ago to arrange for a shipment of carcase beef to United States territory. He had not, however, ascertained the conditions governing the importation of meat into the United States and at the last minute it was found that the United States territories would not accept meat from Fiji, this country not being included in the list of countries from which meat could be imported.

The United States Secretary for Agriculture has ruled that no meat or meat products shall be imported into the United States from any country which does not maintain a system of meat inspection which is substantially equivalent to that of the United States, and, further, that meat and meat-food products are ineligible for importation into the United States under the present regulations of Fiji as they do not provide for veterinary ante-mortem and post-mortem inspection, the disposal of diseased meat, the re-inspection of meat and meat-food products, labelling, the use of preservatives and dyes and adequate sanitation.

In view of this ruling it became apparent that if Fiji wished to export meat she must be furnished with adequate regulations. Now, the United States regulations are contained in a substantial volume of over 100 pages, and at first sight it would appear an impossible task to draw up regulations substantially equivalent to those of the United States without producing something almost equally voluminous.

The regulations of the Central Board of Health had already been submitted to the United States authorities and turned down, and to patch these up to meet the requirements of the United States would have been comparable to the solving of a very difficult cross-word puzzle. As a guide therefore recourse was made to the Meat Export Regulations of the Commonwealth of Australia. As the title signifies they deal expressly with the export of meat and we know them to be acceptable to the United States authorities. With few modifications these regulations have been adapted to our requirements. They are too voluminous to read through now, but I understand that those interested will have an opportunity of perusing the draft regulations.

In support of the title of this paper I would now put before you my ideas of the essentials for successful meat export.

Quality.—Methods of slaughter, dressing of the carcase and transportation have an important bearing on quality. These factors are immediately controllable and can be thus altered to effect improvement at any time—more difficult factors to control are uniformity of type and early maturity. These take years of careful breeding. Good feeding is essential to the production of exportable beef.

It is generally accepted that Fiji is unusually well suited to the production of beef cattle. This is manifested by the quality and size of our cattle. People who have travelled widely say that they more than compare with cattle of other tropical countries. The average dressed weight of cattle slaughtered in the Philippines, for instance, is 110 kilos, equal to 242 lb as compared with 550 lb in Fiji. There is little difference in fact between the average beef cattle of Fiji and those of New Zealand or Australia.

The above remarks, of course, refer only to cattle actually slaughtered, but since the potential production in Fiji is considerably greater than the demand for local consumpton, only the best of the beef cattle supply finds its way to the registered slaughter-houses. There are many more cattle unfit for slaughter owing to poor condition. Lack of condition or quality in Fiji cattle is as a rule not due so much to bad breeding as bad feeding. This latter fault is more the result of overstocking than actual poorness of pasture. Lack of markets in many districts, particularly Taveuni and Vanualevu, has prevented owners from disposing of their natural increase, resulting in many instances in overstocking of available pasture. The animals held on many of these properties would thus not be immediately available for export. The export beef would come from more conveniently situated river-flat pastures which have not been overstocked. A more rapid

turnover of these stock should result. The remoter cattle breeders might then commence to find a more ready local market in filling the gaps caused by the slaughter for export of cattle from those lands more conveniently situated.

The class of cattle required by America is tending more and more to that referred to as "baby beef," which is generally killed between one year and two years old, weighing (live weight) up to 1,100 lb. These animals are the progeny of early maturing stock, raised on the mother and, after weaning, fed with concentrates so that the growth and fattening has been unchecked. The beef cattle raising industry in this country is not yet sufficiently developed to produce "baby beef." The best that can be produced are steers, castrated early, raised with their mothers and grazed on good river-flat pastures not overstocked, so that they reach their prime at about five years old without any setback.

This is the only class of beef which should be considered for export and would be unacceptable unless fat, of uniform size and good conformation. The conformation should be uniform throughout the carcases of any particular shipment so that there is no disparity for instance between sizes of fore and hind quarters. When hung for inspection for purchase at their destination they should appear as neat and trim as a line of well sized and dressed soldiers.

The meat from such beasts would be, I am sure, acceptable to the American public. It would, however, be fatal to future trade to ship carcases of mixed sizes, conformation and inferior quality.

The carcase from the large, long-legged, big-framed, aged bullock is not popular in America. The greatest demand is for beef in the retail trade and American housewives are very judicious in this matter, requiring a small family joint which must be of good quality. The types of cattle producing meat of this class are plentiful in the United States of America and exporting countries have made some advancement towards the production of early maturing beef suitable for export, mainly by the importation and use of bulls of early maturing strains.

When stock are held too long in transit or at the slaughter-house paddocks on poor feed before slaughter, there is a resulting loss of condition at the last moment, reflecting in the quality and weight of the carcase. Care should also be taken to avoid knocking and bruising—in this respect the suitability of hornless cattle for the export market is noteworthy.

Beef cattle intended for export should be quiet and accustomed to being driven. They should be handled quietly and capably to prevent restlessness, injury and subsequent loss of condition.

On arrival at the slaughter-house after a tedious journey cattle should be rested in good paddocks for 24 hours prior to slaughter. If the weather is hot, cold shower baths immediately before slaughter improves the meat.

In bleeding, sufficient time should be allowed for proper bleeding. If this point is neglected the meat is subject to earlier deterioration from putrefactive processes owing to the veins containing blood clots.

The spinal column must be sawn, not chopped, in dividing the carcase.

Avoid the excessive use of water on the carcase; a warm, damp cloth should be used for wiping down.

Supply.—It is recommended that with a view to the export trade intending exporters should, wherever possible, set aside some of their better class land for the sole production of export beef, care being taken not to spoil the potential productivity of the soil by overstocking.

A continuity of supply in the event of the export of meat being attempted is necessary to keep Fiji beef before the public of the importing country in order to obtain the readiest sale and best prices.

Although Fiji has a comparatively large cattle population it is doubtful whether any large number of the right class could be brought together at an early date for export. Three hundred head would probably be our limit for the first year, with a possible building up of the number of exportable beasts to 2,000 per annum in a few years.

Market.—Although the United States of America is the greatest beef cattle producing country in the world there was a decline in the number of beef cattle to the extent of 10,700,000 or 24 per cent. of the total between 1921 and 1927. The vast population of meat eaters in that country (123 millions) is causing a great drain on the beef cattle population and as a result 70 per cent. of the cattle slaughtered are hand-fed and forced for early maturity. This, of course, adds to the cost of production. It is unlikely that production will ever catch up to consumption and it is estimated that the United States will require more and more imported beef.

Hawaii is a part of United States territory and the same remarks apply. It is to Hawaii rather than to the mainland that the anticipated meat export would be made.

Except as ships' stores no other outside market for Fiji meat can be foreseen.

The re-opening of the meat-canning industry might lead to the exploitation of the other Pacific Island groups as a market for canned beef. The purchasing power of these groups, however, is dependent on a good price being obtained for copra. Until that improves there is practically no export for canned beef.

Slaughter-houses.—Properly equipped slaughter-houses are required according to the specifications set out in the proposed Meat Export Regulations. As far as Fiji is concerned very little is needed in the way of improvements to make the existing slaughter-houses comply, but nevertheless some improvements are necessary.

Cold storage.—Where cold storage is not available at the slaughtering premises it is essential that it be available at a reasonably accessible distance. This is the state of affairs existing here. Some cold storage space is available at the premises of two local butcheries and it can be considered as reasonably accessible.

The essentials required of these refrigerators are that they have sufficient capacity and are capable of reducing the temperature of quarters of carcases to at least 16 degrees F. in not longer than 24 hours. Meat must be frozen rapidly, that is, within the above mentioned time. There is then little, if any, bursting of muscle fibres or change in structure. Freezing should not commence until the body heat has left the carcase. Precooling therefore must be provided for. This is done by exposing the carcase, for from twelve to twenty-four hours after slaughter and dressing, to a current of pure cold air.

It has been assumed that the method of refrigeration would be the frozen meat system, mainly because our neighbours, New Zealand and Australia, adopt that system and ships are equipped for it. Since, however, Hawaii is only a fortnight away it would be possible to send chilled meat to that country. Under this system the meat is kept at a temperature of from 28 degrees F. to 30 degrees F. This is just below the freezing point of water. The meat arrives at its destination soft and is ready for immediate consumption. Chilled meat is preferred to frozen meat by the public. It

cannot, however, be kept for longer than five to six weeks. If it can be arranged with shipping companies that method would be found more economical in refrigeration and more profitable in returns.

Land transport.—The distances and time occupied in land transport are short, therefore no elaborate vehicles are necessary. They must, however, comply with the standard of sanitation required by an Inspector under the proposed regulations.

Sea transport.—The export of meat is impossible unless shipping companies are prepared to supply cold storage space. Difficulty might be experienced in arranging this. It is unlikely that the ships' people would be prepared to open their cold storage holds to receive a few carcases only. If sufficiently large shipments can be got together at one time to fill a compartment it is more likely to be well received as cargo, and incidentally should attract more attention when offered for sale at its destination.

The shipping companies must carry the meat in a satisfactory manner as regards stowage, maintenance of an even temperature and general cleanliness. As, however, they are used to the trade and equipped for it, it is not anticipated that there would be any undue risk of loss or damage whilst in transit by sea.

The transport of carcases from cold storage to ships' side and actual loading should be well planned so that the whole process is done without delay. This is necessary to prevent serious rise in temperature of the carcases.

Regulations.—It is obvious that certain standards must be adopted to control the industry but more particularly so in the production of such a perishable article as meat. To do this, in the case of meat intended for export, "Meat Export Regulations" are adopted. Countries which buy the meat demand regulations substantially the same as those in force in their own meat industry.

Regulations ensure protection to the producer, the country of origin as a whole and to the consumer. The producer is protected from fraud by the elimination of argument which might possibly arise as to whether a certain carcase was fit or not for consumption and thus passed for consumption or destroyed. The country of origin has a reputation at stake and regulations ensure that all meat passed for export will be marketed to the satisfaction of the producer in the exporting country and to the consumer in the importing country. Certain standards must be conformed with in dressing the carcase and preparing it for export. It must be sound, wholesome and free from disease. The carcase must be uniformly and neatly dressed and not be mutilated in any way. It must be of good shape, colour and be firm. There must be no deterioration between the time of inspection at the slaughter-house and delivery to the consumer. Re-inspection at the shipping port is provided for. A carcase, passed for export by the Inspector at the slaughter-house may be withdrawn from export on re-inspection at any time before shipment, should it show deterioration. In brief, if the meat offered for export does not meet the approval of the consumer there will be no export.

As far as the consumer is concerned goodness or badness may be obvious or concealed. The part of the regulations which protect the country of origin will ensure that the meat is outwardly good. Without the backing of regulations, however, there is no guarantee to the consumer that the meat is free from harmful properties in spite of good appearance. The Certificate of the Inspector of Meat under the export regulations, therefore, becomes the hall-mark.

The Meat Inspector.—All countries of any importance require that imported meat shall be accompanied by a certificate of ante- and post-mortem meat inspection by a qualified veterinarian. The duties and powers of the Inspector are very wide. From the yarding of the cattle to the stowage of the carcases in the hold of the ship the process is under the supervision of the Inspector. The live animal must pass ante-mortem inspection in regard to disease, condition and quality. This inspection is continued to post-mortem and the whole handling of the carcase must be according to the requirements of the Inspector acting under the regulations. Refrigeration, transport and shipping are also under his observation, and, in addition, the carcase is subject to re-inspection at any time and must be so re-inspected before shipment.

It is essential that there must be available at least one qualified Government veterinarian at Suva for this work.

It will be seen that of the factors for a meat export trade discussed in this paper some are variable according to the energies of local producers whilst others are more or less fixed but subject to variation by advancement of scientific knowledge of general application. Among the variable factors are quality, supply and market. Having established a market, development will depend on improvement in quality and supply. Following that, my opinion is that if we have the goods the market will absorb them. The fixed factors are slaughter-house control and construction, refrigeration and transport.

Conference adjourned until 9.30 a.m. on Wednesday, 14th October, 1931.

Wednesday, 14th October, 1931.

Mr. E. Duncan in rising to open the discussion on Mr. Turbet's paper, " The Stock Industry with reference to the Export of Beef," said that export production at world's prices must be the basis of the development of Fiji. He remarked that development for local consumption would never be successful, as it merely took money from one pocket and put it in another in the Colony and was restricted by the increase of the population of the Colony —a method of development much too slow ever to bring about the cultivation of the spare lands of Fiji or any worthwhile proportion of them within our lifetime. The primary producers of Fiji should be placed in the position to compete in the world's markets and that could only be brought about by reducing our costs of production in every possible direction. Another question bound up with the establishment of the meat export business was the conveyance of livestock at low rates of freight from outside islands to Suva. At the moment there was only one vessel in the Group capable of carrying cattle across the Koro Sea, nam ely, the subsidised steamer " Malake," and cattle freights by that vessel were practically prohibitive. He mentioned that a fat pig which would kill 200 lb dressed weight cost 4s. in freight from Taveuni to Suva, whilst a fat bullock which would kill 400 lb dressed weight or less cost 30s. for freight charges. Mr. Duncan said that not many years ago Taveuni supplied the major part of Suva's cattle requirements. The nucleus of the herds still existed on Taveuni and other islands, and production could be rapidly recovered—even exceeded—given facilities of cheap and proper transport to Suva or factory. He considered that such a factory under joint Government and producers' control would be successful if the necessary support were given by Government. Mr. Duncan thought that the Colony generally would be much better served by the development of an industry so old and successfully tried out in almost all parts of the Colony,

and for which such large tracts of land in the wet and moderately wet districts of the Colony were so eminently suitable, and which was really a non-tropical or white man's sphere of production and income at present than by embarking on new and extremely doubtful and strictly circumscribed industries such as the people were constantly hearing about. Mr. Duncan hoped that the papers and discussions on cattle raising and beef production would lead to early, real and profitable results to the cattle grower partciularly, and also the Colony generally. It was his opinion that if earnestly, systematically, scientifically and promptly followed up, and having assured markets for all its products, the cattle industry would soon—after sugar and coconuts—be the biggest industry in the Colony and a solid and prosperous contributor to its development and finance, provided always that the Government was reasonably helpful. In conclusion Mr. Duncan said that he would like to empahsise that cattle were a necessary supplement to a well-managed copra estate. They saved much hand weeding and brought in a certain amount of income through sale to Fijians and always provided good beef for estate use. In fact, they were a sort of by-product on a coconut estate, and for that reason alone could be produced profitably in competition with any purely cattle-raising venture.

Mr. Bayly remarked that the opening speaker, Mr. Turbet, had said that there was one shipper who had endeavoured to ship meat to Honolulu without ascertaining the requirements of the American Government in regard to the importation of beef into that country. He said that the Company he was interested in had been endeavouring for the last two years, with the co-operation of the American Consul to ascertain the requirements of the U.S.A. Government. He also referred to Mr. Turbet's remarks about the bulkiness of the regulations and said that he had suggested to the Government that this should not necessarily delay the framing of the regulations and that the real work fell on the person desiring to export the beef. Two years had gone by before Government announced that the proposed regulations were being drafted. He quoted from a letter from a Firm in Honolulu to the effect that it would be very difficult at the present day to work up a trade with Honolulu as the Army and Navy had decreed that all beef and, in fact, all commodities required were to be of domestic manufacture, that is, the product of the U.S.A., and he doubted very much if it would be possible to open a market in the U.S.A. territory. Mr. Bayly said that in the opening address it was stated that breeding was more or less subsidiary to feeding. He thought that it was recognised by all people interested in the production of cattle that feeding was an important matter, but the question of breeding could not be overlooked. He said that for the past ten years the men who had imported good strains of breeding cattle could be counted on the fingers of one hand, and that before we could hope to compete in the world's markets we must improve our cattle. With regard to the marketing of baby beef he informed the Conference that his Company had marketed cattle sometimes a little over three years old and they weighed 600 pounds dressed weight. This was done in face of the difficulties of bad roads and transport facilities which may reduce the weight of a beast by 50 to 100 pounds by the time it reached the slaughter-house. He considered that the stock industry was looked upon as the Cinderella industry of the Colony and whenever he wanted a piece of land it was given to him with a certain amount of unwillingness. He again referred to Mr. Turbet's paper in connection with the statement that the best stock was raised on river-flats. He informed the Conference that this cost a great deal more than hill-land and that his Company for one could not afford to have cows and calves on such land. He

did not think for one moment that any man thinking of going into the cattle industry could breed stock on rich river-flats. He then touched upon the question of fencing. In Australia the agriculturists had to look after their fences, but in Fiji the man who was engaged in the raising of cattle had to do the work in connection with fencing his stock. He said that there were no recognised stock routes in the Colony and whenever drovers of cattle had to camp for the night they had sometimes to pay for the water from passing streams. He remarked that he had seen natives who knew that cattle would be driven along a certain road plant up an area of about four chains by half a chain wide hoping always that cattle would pass that way and they would be able to claim damages for their crops. Another difficulty was the tenure of land. At the present time there was a 99 years' agricultural lease, but pastoral leases were for 21 years with an option of renewal for another 21 years. Looking to the future development of the Colony we were forced to the conclusion that if there was to be real development in the stock industry the land tenure would have to be altered. He said that there were thousands and thousands of areas of land in the Colony which were suitable for pastoral pursuits. Two points had been brought before the Conference; one was that Fiji could produce beef of an excellent quality and the other was that we lacked the market in which to sell that beef. He remarked that there was no doubt that at the present time we had not enough beef for export and too much for local consumption, and that before we could enter the world's market we must be in a position not only to produce beef of good quality but also to have continuity of supply. In other beef-raising countries such as the Argentine, South Africa and Queensland there were large tracts of country where the wildest of cattle could be handled with ease by trained men on horses and no fencing was required beyond a few mustering paddocks and sheds at the central station. Every now and then a muster was held and the stock-owners obeyed the unwritten law that unbranded bullocks belonged to the man who had his brand on the mother with which the calves were running. In this way one could produce beef with a minimum of cost, but in Fiji we found that there were innumerable gulleys in the hills and that in an area of 50,000 acres there would not be one single flat area of 50 acres. Cattle which got into these gulleys were very difficult to get out and even sending dogs in after them was useless. The cattle which had wandered into these gulleys generally had to be shot. It meant that fences had to be erected and these fences had to be kept in repair which was a very costly process and required a large outlay of capital and also incidental expense. Another difficulty confronting the stock raisers in Fiji was the lack of suitable grasses. Turning back to the question of land tenure, Mr. Bayly said that his Company had a 21 years lease of certain land and 11 years of that time had expired. He considered that his Company was just on the threshold of the meat industry and that it was necessary to think about an extension. He was endeavouring to improve his cattle by the importation of pure stock and even with set-backs there was always the chance of improvement but it took time. In another ten years he might find himself faced with the expiration of his lease, in which case there would be nothing left for him to do but to slaughter his herd for the value of the hides and tallow. Mr. Bayly went on to say that the question of markets was the most important one that affected the stock industry to-day and he stated without commitment that the Company he was interested in was prepared to erect a cannery for a capacity of 3,000 head per annum provided that they got the assistance from the Government relative to long tenure and also a protective tariff system in the market. He said that he made this statement in all seriousness. In concluding Mr. Bayly referred to the excessive amount of cattle stealing which went on in

the Colony. Every assize at Lautoka there was one or more cases of cattle and horse stealing and he thought that this could be accounted for by the fact that the Branding Ordinance was not enforced. Most of the cases of cattle stealing were Indians, but in some cases Europeans had been guilty. He said that the cattle of Fiji ran into tens of thousands and he was quite sure that less than 100 carried their registered brand. He remarked that for a good many years the ear-mark had been recognised as the mode of ownership, but he considered that the ear-mark was only useful for different ages of cattle and for identification the cattle raisers were deepndent on the fire-brand. He said that he had endeavoured to place before the Conference some of the trials and troubles which faced the stock-raising industry and he would advise any person who was thinking of going into the cattle-raising business to be sure and look after his fences and not to let his cattle get out of control. If he did this he might as well write them off as valueless.

His Excellency said that he had been very interested in the remarks of Mr. Bayly and that the points raised by him would be carefully considered. He assured Mr. Bayly that Government would assist in every possible way. He remarked that he had lately returned from a tour of the Western Pacific and had ascertained that a large quantity of beef was consumed in those Islands. He said that some effort would be made to give a British preference tariff in these Islands which might perhaps assist Fiji in disposing of the surplus meat produced in the Colony. With regard to the question of leases His Excellency remarked that he would investigate this matter.

Mr. Barnes said that the question of the export of beef was not a matter that could be dealt with quickly and he fully sympathized with Mr. Bayly. Voluminous correspondence had been constantly passing in connection with this matter and he could assure the Conference that inquiries had been conducted with the utmost despatch since the matter was first raised in 1929. Various attempts had been made to alter the local regulations in order to meet the requirements of the principal meat importing countries of the world. In this connection the Department of Agriculture had in mind not only the territory of the U.S.A. but also countries of the British Empire which might, were shipping facilities available, be able to take a portion of our output. Copies of the Australian Meat Export Regulations had been obtained and adapted to local requirements. He had the permission of the Governor to submit these draft regulations to the Conference before they were approved by Government. He could assure Mr. Bayly by direction of His Excellency the Governor that the matters that had been discussed would receive every consideration.

Mr. Turbet said that he would support Mr. Duncan's suggestion to form a Meat Industry Board to be established to foster the meat industry of the Colony and devise means whereby this important phase of the Colony's activities might be improved, something on the same lines as the New South Wales Metropolitan Meat Industry Board. This Board had their own slaughter-yards and refrigerators and the whole of the meat business of the metropolitan area of New South Wales was handled by the Board. He said that the cost of this large establishment was borne practically by the profits of by-products; there was no waste in the slaughter of beasts. In connection with Mr. Bayly's reference to the statement that export cattle should be produced on river-flats he said the idea was to bring export cattle to as early maturity as possible and not to prejudice the production of range-country cattle. He remarked that even among the range-country cattle the best could be used for export and the others for local consumption. With regard to stock routes, he considered that if the Meat Industry Board were

appointed this was a question that could be considered by them and there was no reason why stock routes should not be immediately proclaimed. It would be necessary for owners of plantations on stock routes to fence them. He said that he would emphasise the fact that the development of the industry depended on a market in addition to the local market and perhaps the canning of meat would be a solution. The Colony might be able to do more in this connection on account of the greater ease with which the product could be carried than carcases. Referring to the question of branding he considered that the ear-mark was useless as a means of identification of stock. The ear-mark was liable to mutilation, liable to be absolutely cut off. About 80 per cent. of the cattle owners of Fiji used the same ear-mark.

Mr. Bayly said that before the discussion terminated he would like to add a few remarks about the ear-marking of cattle. He considered that the solution of the problem was for the Government to make it necessary for a person to have a proper ear-marking machine. At present the trouble appeared to be through the ear-mark being made with a knife.

Mr. Duncan moved the following resolution:—

That a body should be appointed by the Government to investigate fully the cattle industry of the Colony with a view to examining its present condition of over-production and future possible expansion relative to the establishment of a profitabe export trade associated with similar utilization of other animal and vegetable products.

Seconded by Major Willoughby Tottenham.

Resolution carried.

Mr. Surridge read his paper "The Production and Marketing of Supplementary Crops" as follows:—

Fiji in the past has been accustomed to think only in terms of sugar and copra. More recently bananas attained importance until the embargo was placed on them by Australia. More recently still the dairying and pineapple industries have come into being and are now passing through the difficulties that beset the establishment of new industries. There is, however, one factor which is common to these branches of agriculture and that is that each has "all its eggs in one basket" so that when depression comes there is a hurried look around for other sources of income. Probably the greatest risk incurred in agriculture is that of specialising in one particular branch and to avoid this the question of supplementary crops requires consideration.

Agriculture is probably the most uncertain of all industries owing to the fact that the prime factor on which it depends is largely, at present, beyond the control of man. I refer to the weather. In colder climates this handicap has been tackled with energy in certain branches of the industry, mainly in that of horticulture, with remarkable results.

We have not the same handicap as regards temperature, but our difficulties are climatic, which while favourable to the production of many crops in season and out of season as far as our immediate markets are concerned, handicaps the producer by sapping his energy and initiative to an extent not generally appreciated. It is this latter factor that operates severely in the production and marketing of supplementary crops, for these crops demand of the producer a higher order of energy and initiative than is the case with many of the so-called major crops. Major crops generally may be classed as those required for man's necessity, while many of the supplementary crops may be classified as luxuries, and for successful treatment demand of the farmer the same intensity of treatment that is accorded them in colder

climates, for many of these crops are only in demand through man's business acumen, industry and propaganda. Further, where those supplementary crops have received earnest attention, the returns per acre from such crops are often phenomenal. It is not unusual for gross returns to reach £200 per acre, and under certain systems of market gardening, the gross returns are considerably higher. To achieve this three things are essential—(1) personal organising ability, (2) the ability for real hard work, and (3) the production of crops *out of season.*

The first two essentials are qualifications necessary for all successful enterprises and none more so than when intensive agriculture forms the outlet for such abilities. The third is the basis on which the first two can achieve success.

Fiji is so situated that the climate enables us to produce certain of these supplementary crops "out of season" for the markets that are nearest and of greatest interest to us, viz., New Zealand ,Australia and Canada. I will instance one or two cases from England, illustrating the advantage of being able to produce certain crops out of season:—(1) Tomatoes there realise 3s. to 4s. per lb when put on the market one to two months ahead of the normal season, when this fruit is retailed at 4d. to 6d. per lb; (2) strawberries produced during winter have realised £1 per lb avoidupois; the normal season price would be from 4d. to 8d. per lb; (3) grapes during the winter and early spring will fetch 10s. to 15s. per lb; during the season they have been retailed at 1s. per lb; (4) pineapples from an English hothouse will fetch 10s. to 15s. per fruit. Imported fruit has been retailed as low as 6d. each.

These differences emphasise the value of supplying produce when it is out of its normal season, on various markets, and the extra cost involved is more than compensated by the higher price obtained. With these examples in mind and the fact that the climate here is generally favourable for the production of fruits and vegetables at those times when they are out of season elsewhere there would appear to be ample scope for us to concentrate more thoroughly and effectively on certain supplementary crops to our advantage. The crops that occur to me are tomatoes, cucumbers, melons, pumpkins, French beans, egg-fruit, kumalas, pineapples and bananas.

Before passing on to a discussion of the various crops there are certain factors concerning production that should be considered.

Climate.—I have already stated that we have the climate to produce certain crops at times of greatest scarcity in other countries, but it is necessary to differentiate between these crops. Some of them are tropical, some sub-tropical, while others are on the border line of sub-tropical and temperate climate crops. For this reason discretion is necessary in the methods and locations adapted for the production of the crops in question. Tomatoes, for example, do not give maximum yields at temperatures exceeding 80 degrees F., the optimum lying between 60 degrees and 75 degrees. Again, while requiring the maximum of sunlight in a temperate zone, tropical sunlight is probably too strong and therefore detrimental. Much work requires to be done to discover the optimum conditions for those introduced crops which we, by long association in more temperate climes, assume should do just as well here.

Tools.—If we examine the tools in general use on a plantation it will be noted that progress has been made with reference to horse or tractor implements, but hand implements remain the same as when indentured labour was first introduced. The cane knife is a very light and useful tool, but the

square hoe is a very heavy and cumbersome implement and one which, in my opinion requires the maximum of effort while achieving the minimum result.

The object of hoeing is to destroy the weeds and move the soil, thereby producing a fine tilth and mulch one inch to two inches in depth. To secure this desired result a horse hoe should first be worked between the lines and then followed with a light hoe, for example, the swan-necked draw hoe type which properly used will achieve the object of hoeing to greater advantage in that it is easier and lighter to manipulate and therefore not so hard on the labour, enable the work to be done more efficiently and more expeditiously, and allows of a closer working around the plants at all stages of their development. I have discussed the hoe at some length because it is perhaps the most important and useful implement in the successful production of supplementary crops.

Too much emphasis cannot be laid on the necessity of getting in amongst the crops with this implement as early as possible; that is, as soon as the plant is big enough to be distinctly seen, or in the case of transplanted ones, as soon as it is observed that the plants have taken hold and are becoming established. Attention to this detail ensures stronger and healthier plants with a resultant increase in returns.

Sowing.—This is controlled by market requirements and the object is not only to sow for the earliest market but to sow in succession to ensure a regular supply right through the season. Apart from quality of produce nothing tends to stimulate and maintain a demand for that produce as the regular supply of a good standard article. The first sowing therefore will be made at a time sufficiently in advance to ensure that the plants will commence bearing when required. Sowings in succession about every three weeks will maintain the supply and avoid failure.

Objects of production.—Obviously when producing a crop it is essential to know the purpose for which it is required. With those crops under discussion the main purpose is for human consumption, as fresh fruit or vegetables, but other objects should be considered. It is expected that our nearest markets will continue to absorb the produce we supply, but we have had one experience of a market being deliberately closed to our produce and such might occur again. Hence the necessity for preparing for such an event and thus making the production of supplementary crops a permanent industry. England is pointing out to us methods to be pursued, for having suffered year after year with gluts of fruits of various kinds, and also importing huge quantities of such produce, the question of food preservation by canning, &c., is now being tackled with remarkable success. In our case, the question of the disposal of our produce by canning, sundrying or for juice extraction should be seriously considered for it would enable our produce to be sent wherever there is a market, at all times of the year, thus extending our sphere of influence and increasing our prosperity. This is being done with pineapples and can be done with other crops. Further, we have already a small trade in seeds, I refer principally to Mauritius Bean, but it is possible and the matter is now being investigated, that certain other crops may be grown not only for the table but for seed purposes also. In this way waste would be eliminated and the producer would have an extended market and a more uniform return for his labour.

Rotations.—One of the greatest difficulties met with in intensive cultivation is the continuous supply of manures other than artificial manures. With the increase of motor traction, stable manure is almost unobtainable in some countries, and here in the tropics what little is obtainable is rapidly

exhausted in the soil owing to the high soil temperature which facilitates decomposition. There is, however, a method by which this lack of suitable manure may be largely obviated, that is by the practice known as "crop rotation."

The food requirements of each crop vary, as also do the root habits of those crops; some travel deeply, others are surface rooting, while some again leave the land richer and in a more friable condition, as is the case with most leguminous crops. If the same crop is grown continously on the same land it is obvious that pests will have a continuous supply of food, and control of pests and diseases will be rendered more difficult.

In working out a system of crop rotation those facts should be borne in mind and the utmost use made of any leguminous crops grown either for export or for their green manurial value as a means of supplying plant food deficiencies, humus to the soil and changing the crops to be grown. Plants of the same natural order should not be grown in the same soil since they usually offer themselves as alternative hosts to the pests and diseases of the previous crop. By careful rotation, then, the soil is not so readily exhausted and pests and diseases are not given the same opportunity to produce themselves at the grower's expense. The longer the rotation, that is the greater the interval of time that elapses before a crop occupies the same land a second time, the greater the benefit to that crop whether for food supply or from the point of view of plant sanitation.

It does not come within the scope of this paper to discuss pigs and poultry, but I suggest these animals for inclusion in a crop rotation. Experience in England, America and elsewhere has demonstrated that this is both practical and valuable. Both animals are bad gardeners when allowed to roam amongst crops but if suitable pens are made that are strong and portable and high enough to contain either the pigs and/or poultry they can be moved on to the land as soon as a crop is finished, to clean up the residue of that crop, destroy the weeds and insect pests, and add valuable manure to that land, as well as giving meat and eggs in exchange for the waste materials supplied.

Crops.—The following are brief cultural details of the crops under consideration, together with a produce list that will indicate the export season for the various crops.

Tomatoes (*Lycopersicum esculentum*).—Require a good rich well drained loam. Seed should be sown in light rich soil some 3—4 months ahead of when required to fruit. I would suggest that all seed beds be thoroughly watered with a solution of the Cheshunt compound, as a preventative to the "damping off" and other soil fungi that attack the young plants. Transplanting should be done when the seedlings are 4-in. to 6-in. high and at the time of transplanting each planting hole should receive at least one pint of the above solution, the same amount being given after the transplanting. The Cheshunt compound is not a panacea for all soil ills of the tomato but it is of great assistance in the prevention of soil fungous disease and usually repays for application by avoiding the necessity for replanting. Further, the solution stimulates the young plant and tends to prevent the check occasioned by transplanting. When the seedlings have become established they should be carefully hoed and should receive frequent hoeings as long as it is possible to work amongs the plants. When the plants are in flower pollenation may be assisted by lightly shaking or jarring the plants, usually at mid-day. Plants may be set at distances varying from 18-inches to 36-inches depending on soil, variety and method of staking, for plants usually do better staked than trailing as a vine. Water should

be given as required to maintain steady growth until the blossom buds appear. During flowering the plants should be kept on the dry side until the first truss has set when liquid manure should be supplied with or without a surface mulching of decayed manure, leaves, &c. As growth proceeds all side shoots should be pinched out until the fourth truss has set when a strong leader, the second shoot below the point of stopping, should be allowed to start out to continue the crop.

A good artificial manure to be applied when preparing the land is:—
Superphosphate 5 cwt per acre.
Sulphate of Potash 2 cwt. per acre.
Sulphate of Iron ½ cwt. per acre.

When fruiting, some advise applying nitrate of soda or sulphate of ammonia at the rate of 2 cwt per acre, but others maintain that a nitrogenous manure depresses the yield., It is recognised that the tomato responds to potash and phosphates, but nitrogen should be applied with discretion.

Disease.—Those diseases met with here are usually soil fungi which, in the present state of our knowledge are beyond definite methods of control.

Soil sterilisation on a large scale is not a practical proposition in Fiji; therefore the best means of defence is to use as far as possible resistant varieties, *e.g.*, Marglobe, Norton, to destroy infected material by burning and to rotate the crops as already suggested. Attention to plant hygiene and more knowledge as to methods or locations for cultivating this crop offer fields of investigation which will be dealt with as early as possible at the Government Experimental Farm.

Cutworms are often a serious pest to young plants. The method of control is the use of arsenical sprays or arsenical baits. The better way would be, in my opinion, to introduce poultry into the rotation.

Cucumbers (*Cucumis sativus*).—This crop will stand a rather higher temperature than tomatoes provided plenty of moisture is available. The soil required consists of two parts good rich loam to one of well rotted manure with a liberal admixture of sand to keep the whole open and porous. If a compost of this mixture is made up, then planting holes 18-inches diameter and 12-inches deep may be dug and filled with the mixture ready for the seed when planting out. The large amount of humus in this compost will keep the soil moist.

Liquid manure should be given freely when the plants have reached the limit of space allowed them, and while fruiting. Each fruiting stem should be pinched at the second leaf beyond the fruit; continuous and judicious stopping is necessary throughout growth. When practicable, pollination should be carried out since this ensures a more certain crop and is easily done, both male and female flowers being on the same plant.

The three essential points with cucumbers are:—
1. a rich friable compost;
2. frequent applications of liquid manure and water;
3. continuous and judicious stopping throughout growth, and finally, one that needs investigation, protection from excessive light.

Melons (*Cucumis melo*).—Require a firmer soil than cucumbers, more light, and less water, and therefore a drier atmosphere.

The best soil is that obtained from well rotted turves from grass land; this mixed in the proportion of 2 of soil to 1 of well decayed manure plus basic slag (2 lb) superphosphate (1 lb) to each load of the compost forms a suitable mixture. Cow dung is excellent for the purpose.

Sowing should be 2 to 3 months prior to fruiting the plants being 1-foot to 2-feet apart, and when from 15-inches and over in length should be top dressed with the compost and the points pinched out to encourage fruiting. The laterals should be treated in the same way by pinching at not less than 1 joint above the fruit; this will avoid overcrowding. When watering, the stems must be kept dry, otherwise they are liable to rot. As with cucumbers pollination should be carried out. It is recommended that plants be restricted from 5 to 8 fruits according to the vigour of the plant and size of fruit desired. Judicious watering with liquid manure during fruiting will add to the size and quality of the crop.

Pumpkins (*Cucurbita maxima*).—Soil requirements are similar to those of the cucumber and melon in that a good rich soil is required. Seeds may be sown in holes previously prepared in a way similar to that required by the cucumber, some three months or so before the fruit is required, the vines being allowed to run over the ground without supports. Liberal waterings either of water or liquid manure should be given as required.

French beans (*Phaseolus vulgaris*).—This is a crop that has not received the attention which it appears to deserve, for export purposes. There is a limited market in Auckland from May to October, capable of absorbing according to present information about 1 ton of these beans a month One consignment of French Dwarf and Canadian Wonder—some 35 lb in weight—was despatched recently to New Zealand where they realised 9½d. per lb, equivalent to 4·3d. per lb on the wharf at Suva As this shipment occurred near the end of the season it is reasonable to suppose that prices should be more advantageous earlier in the year. Even so the return is higher than is obtained in the local market.

Deeply worked soil is essential together with a dressing of lime (1 ton) or coral sand (5 tons) superphosphate (4 cwt.) and sulphate of potash (1 cwt.) per acre. If compost or well rotted manure is available it should be sown in the furrow over which the beans will be planted.

Seed should be sown in treble rows, at about 9-inches apart in rows that are 2-feet apart centre to centre. Sow at intervals of three weeks throughout the season. When the flowers have set and the pods are forming applications of water and liquid manure would be beneficial to ensure rapid and succulent growth as beans for overseas must be tender to secure a fair price.

It is possible, however, that a certain proportion of the crop will be too old for shipment, or local prices too low to give a satisfactory return. This difficulty is at present being investigated along the following lines. At the Government Experimental Farm at Navuso a proportion of the crop was allowed to run on for seed. Samples of this seed are being despatched to Auckland and Sydney for examination and report, and if its germination and bearing qualities have not been impaired by production in the tropics and if reasonable prices are offered for sound clean seed of certified germination and purity, the growing of French beans for export, both for table and seed purposes, should be profitable.

Egg Fruit or Bringals (*Solanum melongana*).—Cultivation is very similar to that of the tomato. Seed should be sown in boxes containing light rich soil and the seedlings transplanted when about 3-inches high into rows 3-feet by 2-feet. The hoe should be used freely as in the case of the tomato to maintain a good soil mulch. If possible a mulching of rotted manure and leaves should be given. Plants yield an average of 12 marketable fruits a season.

Varieties:—The purple is favoured in our markets, but the white might be worth while trying although stated to be of not such good flavour.

Kumalas (*Ipomœa Batatas*).—The sweet potato is familiar to us all and forms a useful export crop apart from that required for local consumption. A good moderate friable soil is required which should be well and deeply cultivated, and ridged, the ridges being about 2½-feet apart. Cuttings should be planted in the ridges at about 12-inches to 18-inches apart. Better results are obtained from cuttings than from tubers and it is a good plan to plant tubers in nursery beds and then cut off the stems when a foot long and plant these. Planting should be done for preference during rainy weather, and when the plants have rooted they should be hoed, care being taken not to damage the foliage. At the second weeding a final earthing up should be given. The crop matures in about 4 months and returns about 4 tons to the acre. Crop rotation should be practised. This crop greatly benefits the land by the continuous cultivation given up to and during the harvest. The leaves are excellent fodder.

Varieties:—The white preferred in the Canadian market. The red and pink preferred in the New Zealand market.

Pineapples (*Ananas sativus*).—At present we are concentrating on the canning pine—the smooth leaf Cayenne and no attention is paid to producing a good quality dessert pine either for local or export trade. The "Ripley" pine is probably the best, being very sweet and a good traveller, but stocks have deteriorated and the matter is receiving attention by the Department both as to stocks, quality of fruit and methods of marketing, to discover the possibilities of this branch of the trade. If Queensland can export pineapples at a profit to New Zealand, there is no reason why we should not do at least as well. We should do better.

Bananas (*Musa sapientum*).—This crop is receiving considerable attention at present but the methods of packing, transport and marketing of this soft fruit need careful investigation so that our market may be extended beyond New Zealand.

There are other crops that will occur to you, but in all cases the fundamental principle behind successful crop production is care and attention at all stages from the sowing of a crop until it has been placed on the market.

Marketing.—If crop production is a science the marketing of the crop is not less a science, demanding just as much energy and concentration of effort to secure a successful result. The producer should so handle his crop that by putting good quality produce on the market in as attractive a manner as possible the consumer will be induced to buy at all times.

Handling of Produce.—With all perishable produce the greatest care is necessary and should be enforced at all stages between the plantation and the steamer at Suva.

Bananas are rough handled from the time they are cut off the tree until they are packed into the case and sometimes after. Untortunately much of the damage is not apparent until after the fruit has left Fiji. In view of the increasing competition from Samoa and Cook Islands, it becomes increasingly important that the utmost care should be exercised. The difficulty is that of educating those people immediately concerned.

With tomatoes the fruit should be gathered and either automatically graded and packed directly into the case or else taken to a cool packing shed on the plantation to be packed for markets. The present system which involves collection from the plant into any available receptacle, carting to a central packing station, when the fruit is dumped on the floor in heaps 2-feet or more deep and perhaps left overnight before being packed does not tend to improve such a soft fruit. The present method of grading

involves selection from the heap so that the fruit is handled many times to secure the correct sizes. It is hoped shortly to improve the system.

One can appreciate the amount of bruising possible under such conditions. After packing, the fruit is carried in lorries to Suva, the vibration by no means improving it; the voyage from Suva to the markets occupies several days.

Such a system is wasteful of time, fruit and energy. It is typical of the treatment accorded to most produce exported from Fiji and represents how *not* to do things. I would repeat that to ensure produce travelling well and arriving in sound condition on the market, the greatest care and attention should be given at all times.

Packing.—All are familiar with the attractive packages in which various commodities are received from overseas for sale in this Colony, and without exception both the sales and prices obtained represent a reasonable profit to the producer or manufacturer. These attractive packages are the result of sound business acumen and keen competition. The most familiar goods with us are the Australian fruits in cases or cans, Californian fruits in cartons, cans, &c., and confectionery. In each case the producer and manufacturer has realised that he has something worth selling and has induced the consumer to appreciate the fact by the type of package in which the goods are marketed. Contrast this with the cases which leave Fiji fillied with bananas, oranges, tomatoes. If the timber for these cases was dressed a marked improvement in appearance would immediately be observed with negligible additional cost. Where paper wrapping is allowed, further improvement in appearance can be effected by lining the box or wrapping the fruit in white or coloured paper.

Finally, an important point in packing is overlooked in this Colony. Certain classes of produce allow for definite methods of packing and since in many cases the first or bottom layer in the pack is more uniform and attractive that the last, the mark or brand should be placed upside down so that when the case is filled the lid will automatically be made the bottom of the case. In this way the mark indicates " right side up " and the best layer receive due prominence.

Grading.—Having secured improvements in handling of the produce and the containers used, the next step is to grade the produce. Many consider grading unnecessary, but it will be found that the keener the competition the greater the necessity for grading in order to market a standard product. A case of fruit of good quality, well graded and packed and marked accordingly will always command and maintain a higher price even in times of glut.

The merchants in Fiji who import apples, &c., buy those apples on the brand, never seeing the fruit until after arrival in the Colony. Such brands by careful attention to the points already enumerated in this paper have obtained such a reputation for quality, &c., that confidence is inspired in customers hundreds of miles away.

In many branches of agriculture and industry grading has been introduced by legislation owing to the stress of competition, with the result that ungraded produce has no sale outside the local market.

Standard or National Mark.—Many successful business organisations can trace their success not only to the quality of goods produced but to the adoption of a " Trade Mark." To-day many countries have adopted a national mark as an indication not only of the country of origin but also as a recognised standard of quality. This adoption of a standard or national mark represents one of the best and cheapest advertisements for assisting good quality produce on the market.

Fiji is without such a mark at the present time, but that registered for use by the Department of Agriculture, viz., the Fijian's head over the word Fiji, is one that is distinctive and attractive, and through the efforts of the Department is becoming recognised as a standard of good quality produce. This mark should form the basis of a national mark for produce of recognised quality and packing exported from the country. I commend this to your serious consideration.

Fruit Preserving and Fruit Juices.—The preserving of fresh fruit by canning is already practised in Fiji with reference to the pineapple but I look forward to the time when our canneries will not restrict themselves to one crop but extend their operations to include tomatoes, fruit juices and other products. With our climate and soil many varieties of fruits and vegetables can be successfully grown but as this branch of agriculture extends, means to market surplus crops will have to be considered so that our export markets may be extended beyond New Zealand and Australia. Many fruits and vegetables can be canned or sundried or both, others are suitable for essential oils or juice extraction. Recently a proc ss has been invented and patented in England by which fruit and vegetable juices may be extracted and preserved indefinitely without the addition of harmful preservatives. The process, called the "Matzka treatment" involves the destruction of organisms producing fermentation, putrefaction and disease present or likely to be present in the freshly extracted juice. Such a process would tend still further to eliminate waste and extend the possible markets open to the producers.

Co-operation.—Co-operation has been preached in many places for many years with varying success. One of the first of the agricultural countries to adopt and extend the idea was Denmark, when some seventy years ago, the agricultural industry put its house in order and established the co-operative movement throughout the land. The result has been that the Danish producers are a very prosperous community and one of the most serious competitors that the Empire dairying industry has to face.

The fruit growers of California have, in more recent years, demonstrated the value of "getting together" by the way in which their fruits, &c., are spread in many markets. In Great Britain, several agricultural communities appreciating the benefits of "getting together" to purchase and to sell produce, have formed their co-operative societies with advantage to themselves.

In Fiji co-operation is familiar to the native, but not to the other residents in the Colony. During my peripatetic work I have discussed the advantages of co-operation amongst copra and other producers. Interest has been aroused only to subside apparently for the lack of will to pull together.

Co-operation is not a panacea for all marketing troubles, but a band of producers combined together can more successfully enforce the benefits of packing grading and marketing of produce than the individual. Machinery for grading and packing could be obtained by such a body and transport, canneries and shipping facilities improved.

Time does not permit of a full discussion of this point, but it is offered for the serious consideration of all concerned.

Propaganda.—Before concluding this paper, I would draw attention to the old axiom, "it pays to advertise." Some fifty years ago, the banana was considered a luxury fruit on the English market. It is now a popular fruit on which an enormous trade rests. This has been brought about by propaganda, in which the health and dietetic value has been broad-

casted under such slogans as "Eat more bananas," "Bananas are recommended by the medical profession." The success of this and other industries has been largely due to suitable and vigorous propaganda carried out by the particular branches of industry concerned.

Fiji cannot afford to hang back, provided she has the quality goods to offer, and if co-operation amongst producers can be brought about, propaganda dealing with their various products should be conducted so that the produce is known outside of Fiji.

In conclusion I would suggest that co-operation grading, packing and efficient propaganda constitute very important essestials in the successful marketing of perishable and other produce.

Appended is a "Produce for Export" list indicating the seasons most profitable for export, and the markets concerned.

PRODUCE FOR EXPORT.

Crop.	*Season.*	*Destination.*
Bananas	January–December ..	Auckland.
Beans—French ..	August–October ..	Auckland.
Mauritius .	July–November ..	Sydney, Brisbane.
Bell Apple . ..	June	Sydney.
Coconuts (whole) .	January–December ..	Vancouver.
Cucumbers . ..	May–October	Auckland.
Egg Fruit . ..	June–December ..	Auckland
Ginger	March–October . ..	Sydney, Vancouver, Auckland.
Grenadillas . ..	January–December ..	Auckland.
Kumalas	June–November ..	Sydney, Vancouver Auckland (August),
Mandarins . ..	March–June	Auckland.
Melons	September–February ..	Sydney, Auckland.
Oranges	March–June	Auckland.
Papaya	September–December .	Auckland.
Peanuts	March–June	San Francisco (March), Auckland (June).
Pines	October–January ..	Auckland, Vancouver.
Pumpkins	September–February ..	Sydney.
Tomatoes	August–December ..	Sydney (August–October). Auckland (October–December)

Major Joske said that it was a great pleasure to listen to such a full and interesting paper as the one read by Mr. Surridge. He did not think that Mr. Surridge intended to convey the idea that any European could make a living out of pumpkins, tomatoes, &c. He suggested that the co-operation of the Chinese Consul, the Secretary for Indian Affairs and the Secretary for Native Affairs should be sought in connection with this subject as the large proportion of pumpkins, tomatoes, melons, &c., were exported by Chinese, Indians and Fijians, and it was to them that we had to look for the production of these crops in the future. He remarked that one of the leading Fijian Chiefs had said to him "Why don't we have a Fijian Agricultural Conference?" Why also were not Indian and Chinese Agricultural Conferences held? The Conference had heard a good deal about the future development of the banana industry in Fiji; in relation to supplementary crops we had products which were solely in the hands of Fijian, Indian and Chinese population so that again he expressed the need for the Department of Agriculture to extend their advice, their sympathy and their help to the Indian, Fijian and Chinese growers. He said that as far as bananas were

concerned we should be able to meet the competition from Tonga and Samoa and if we could not then Fiji deserved to lose the trade. He said that Mr. Surridge had mentioned in his paper that £200 per acre per annum could be made from the cultivation of certain crops. He wished that it was possible to convince some of the present settlers in Australia and New Zealand of these figures. He knew of many thousands of acres of land which were available in Fiji at a nominal rental of £1 per acre per annum. Major Joske remarked that tomatoes were a very useful crop which was grown almost entirely by Chinese, and these had been bringing into the Colony something like 8s. or 9s. per case, which was a point well worth considering by our Asiatic population. The co-operation of the Chinese Consul should be sought in translating the very excellent cultural notes of Mr. Surridge's paper for circulation.

With regard to the question of grading, Major Joske intimated that if grading of bananas was undertaken then the system of purchase would have to be altered. At the present time bananas were bought by the case and it was possible that a loss would be sustained by grading the fruit in Suva. If the system were altered and purchases were made by weight, payment being made at so much per pound, this would get over the difficulty. In Fiji bananas were grown in very scattered districts and not in plantations as they are in Australia.

Touching on the question of co-operation he said that this was a very difficult thing even among Europeans of the Colony and he thought that it would be extremely difficult to devise a workable scheme amongst the Fijians, Indians and Chinese. As an example of co-operation he referred to the Coconut Planters' Union Limited which comprised members of the copra producers. This Union had been running for something like ten years; it was concerned solely with the collecting and shipping and selling of copra and had been successful for two reasons; firstly, because it had dispensed entirely with trading, and, secondly, that it had dispensed entirely with ordinary politics. These two factors he said had been the cause of the wreck of most Co-operative Societies in the Colony. In normal years the Union distributed amongst its members somewhere between £25,000 and £100,000.

With reference to propaganda he thought that this was an excellent thing and could be easily managed as far as the European producers were concerned, but with regard to Chinese, Indian and Fijian producers he considered that it would be very difficult to convince them of the advantage of advertising in Auckland and elsewhere. He remarked that on a recent visit to Auckland he had been accused of advertising over the air. He considered that there was a very definite necessity for advertising and he thought a small export levy might be made on the export of bananas for instance, the sum realised to be spent on the advertising of Fiji fruit in New Zealand. He would not suggest a small insert in the daily papers, but considered that the scheme should be put in the hands of an Advertising Agency and a day or so before the "Tofua" arrived in Auckland signs depicting Fiji and Fijian bananas should be shown in the picture theatres. He remarked that those who had visited the Agricultural Show would doubtless have seen the very fine posters which had been prepared advertising Fiji and he considered that there was excellent local talent available which should be utilised.

There was one other small point that he would like to direct the attention of Mr. Surridge to and that was kumalas. Mr. Surridge had shown the season for kumalas as from June to November, the Auckland season commencing in August. His experience had been that the season was now over for all practical purposes. The season had been a good one for kumala

as far as Fiji was concerned because the local crop in New Zealand had been a failure and the cold weather had lasted longer in New Zealand than normally. The Maori was the principal consumer of kumalas, but they did not eat so many in the hot weather as they did in the cold. He informed the Conference that when the returns of the last shipment were received it would be found that the price had dropped considerably. In connection with the development of pure line seed, he remarked that Mauritius beans had been grown for many years in Fiji and should be encouraged, but unless something was being done to improve the seed he considered that the quality would deteriorate. He would like to see the Agricultural Department, if it was not already doing so, develop suitable strains of Mauritius beans which would be suitable for use in this Colony. Some results had been obtained with the growing of Sonacalif rice seed and although it was rather early to come to a definite conslusion in this respect there was every indication that this would improve the quality of rice produced in the Colony.

The Chairman suggested that the paper on the Pineapple Industry should be now read and discussed in connection with Mr. Surridge's paper.

Mr. Barnes read Mr. G. Garrick's paper "Pineapple Growing for Canning" as follows:—

Selection of land.—Pineapple growing in Fiji has been carried on sufficiently long to prove that certain theories, accepted and established in Hawaii, do not apply here where selection of land is concerned. Pineapples will grow and produce equally well at sea leavel as they will at 500 feet above sea level. Suitable land may be described as low undulating hills which can be worked by machinery. Steeper country is equally good, but expensive to work. Experiments being carried out on river flats are not yet complete and until completed it is suggested that such land be avoided for pineapple cultivation. Fruit produced on river flats may appear perfect, but if the soil contains too much moisture then, as likely as not, the core of the fruit will be found to be a brownish colour and such fruit will be rejected by the factory as being unfit for dcanning. Provided pine apples are cultivated on hill sides and drainage is good, a heavy rainfall is not an adverse factor.

Nature of soil.—The soil on the Island of Ovalau has been and is producing a pineapple which when canned has been pronounced by experts to be equal to if not actually superior to, the highest grade of canned pineapple for sale on the world's markets. The soil of Ovalau where extensive cultivation of pineapples is being carried on, is of reddish brown colour. When dry it is very loose and friable, and after rain drains itself very quickly. The iron content is good and in a form easily and readily absorbed by plant life; this feature is essential to successful cultivation of pineapples. The localities referred to are Wai-ni-Loka, Bureta, Waidau, and Viro. Experiments carried out on river flats at Waidau should be sufficiently finalised by December, 1932, to decide the suitability or otherwise of this class of land for pineapple cultivation.

Drainage.—Proved suitable land will drain itself, *i.e.*, hill land. It is sometimes necessary to instal a system of drains to prevent erosion. No hard and fast rule in this respect can be laid down and the particular nature of the country must decide the system to be adopted. The general principle is to select a natural valley or water-way and into this lead feeder drains cut so as to permit the water to flow slowly. The thing to be avoided is a sheet of water coming down a hill-side carrying tons of soil with it.

Preparation of soil.—Hill-sides with an angle of slope not exceeding 25 degrees may be ploughed. From 25 to 45 degrees should not be deeply cultivated owing to subsequent rapid erosion from heavy drains. The pineapple plant has a small root system, which does not need deep tilling as has been proved from experience. If the land is as described under the title of "nature of soil," then all the "cultivation" necessary can be done with a mattock, and a strong arm. Dig a hole some 8 inches in diameter and 5 inches in depth and loosen the soil so dug and replace in the cavity it was dug from. This method is cheap and will produce excellent results. It is time enough to use the plough when exhausted ratoons have to be ploughed out.

Selection of plants.—Plant material may consist of (*a*) ratoon suckers which come from the ground level, (*b*) suckers or sprouts which come from the parent plant above ground level and (*c*) slips which come from immediately under the base of the fruit. The suckers and sprouts are much more plentiful than slips, so for practical purposes let us keep to the firs two. These should be selected from strong and vigorous plants and detached when from 8 inches to 12 inches in growth. When detaching wear a strong leather glove and insert the thumb well down between the parent plant and sucker or sprout to ensure making the break right at the parent plant. Crowns should be selected for their smallness. Large crowns should be avoided as these indicate a large core. Crowns are cut from the fruit, not broken off.

Treatment of plants prior to planting and planting.—All plant material should be exposed to a strong sun, root end up, for at least seven days. These are then peeled, *i.e.*, about six or eight of the small leaves removed and the stalk cut square off. They are then ready for planting. Two rows planting 18 inches by 18 inches with 4 inches spacing gives about 8,600 to the acre; three row planting 12,400 and four row 13,600 to the acre. The mass planting gives an increased tonnage with a decreased diameter of the fruit, which is desired by the factory. A great deal could be written on the subject, but for practical purposes the above should be sufficient to meet all preliminaries.

Weeding.—Pineapples should be kept fairly clean of weeds, and by hand this will cost anything from 17s. 6d. to 25s. per acre for each weeding. The rainfall usually regulates the number of weedings necessary and that all important factor known as experience.

Harvesting.—Again experience only can teach when to harvest. This fact, however, must be remembered: the pineapple stores its starch in the stem which attaches it to the plant, and it is not until the fruit commences to ripen that the starch is converted into sugar and absorbed by the fruit. Therefore, if a green or partly ripe fruit is removed from the stem, the process of sweetening is at once arrested. If planters supply or attemp to supply unripe fruit to the factory they will be met with a withering blast from the canner, because he has to add cane sugar to make up the deficiency of fruit sugar.

Transport.—Handle ripe pines as you would a basket of thin shelled eggs. Bruised fruit is "unfit for canning" and in that expression are a mountain of argument, hard words and strife and a smaller cheque than anticipated.

In conclusion the only fruit which is "fit for canning" is the lucious pineapple known as the "Smooth Cayenne."

Mr. Riaz.—In the absence of Mr. Godfrey Garrick it has devolved upon me to speak on the important subject of the Pineapple Growning and Canning Industry in Fiji.

It appears to me that there are three heads under which the pineapple business should be dealt with—growing, manufacture, advertising and marketing.

That Fiji can grow a pineapple suited in every way for canning is an established fact. This being so we have only to decide on what is the type of soil most suited to the requirements of the plants, and what method of cultivation should be adopted. Generally speaking, the pineapple in common with all other cultivated crops requires that the soil be deeply and thoroughly ploughed and brought down to a fine tilth before the plants are put in. The pineapple plant, contrary to the belief widely held, has a deep rooting system. I myself have traced the roots to a depth of 2 feet. 6 inches. Intermediate cultivation should be carried out by pony-plough and scarifier until the plants are out of hand. Colour of the soil does not seem to give much indication of its fertility for pineapple growing, though it is as well to avoid planting on heavy black soils as indicating a high manganese content. This constituent in the soil is detrimental to the health of the plant.

Soils that carry a high oxide of iron content grow the healthiest plants and produce the soundest fruit. The plants like a fairly high acid soil, but good drainage and dry feet are absolutely necessary. Sloping land is the most suitable, with small catchment drains dug around the tops of cultivations, and a system of contour planting should be carried out, *i.e.*, the rows should be across the slope of the land and *not* up and down the hill sides.

Preparation of plant material.—The experience on Votualevu, Nadi, is that just as good, or maybe slightly better results are obtained if the suckers are put in directly they are detached from the mother plants without sun-drying or stripping off any of the leaves. Only one of our growers strips the leaves off his suckers, and he does not seem to have had fewer losses from plants dying after planting than other growers. This gentlemen has planted close upon 100,000 plants this year with a loss from death of 30 plants. The total number planted for the year is in the vicinity of 600,000 with a total loss of 100 plants through rot, so it would appear that on the score of cheapness it is better to avoid the expense involved in the stripping, extra handling and sun-drying of plants. We strip all plants off the main plant leaving all shoots from the ground for the bearing of the ratoon fruit.

Harvesting.—Like all other fruit the pineapple must be handled carefully when being harvested, and during transportation to the cannery. The fruit should be left on the stalk until the colour is showing yellow for about half way up the fruit. If these points are observed the fruit may be kept for as long as 10 days without deterioration. Bruised fruit ferments rapidly, and is therefore not suitable for canning if it has been harvested over 12 hours.

Out-put.—Within the space of 10 years from now my Company, by natural expansions from our own plant supplies, will be faced with the problem of having to handle 1,000,000 cases of canned pineapples. Then comes the most important question of cheap supplies of Empire cans, automatice pineapple-canning machinery, advertising, marketing and cheap freights.

Empire can supplies.—Up-to-date British can manufacturers have not been prepared to supply collapsed can bodies and covers, and we have therefore been forced to obtain our supplies from the American Can Company.

Can reforming machinery.—Can reforming machinery and closing machines have had to be hired from the American Can Company, which

necessitates our purchasing spares from that Company, all of which are manufactured in America, and therefore have to bear heavy duty.

Canning machinery.—In the past we have had to purchase all our canning machinery from America at high cost and after the 28th June next, just when we will be entering into our first period of expansion, we will be faced with having to import from that country large quantities of canning machinery without the benefit of a rebate of the duty levied on such machinery, because that concession expires on that date. As there does not appear to be much chance of British Manufacturers giving us this type of machinery before the 28th June, 1932, this may not be an inopportune time to suggest that the Government extend the period for a further two years, *i.e.*, to the 28th June, 1934.

Freights.—At present freights to overseas markets are too high, but doubtless when we have large shipments to despatch we will be able to obtain more advantageous rates, and so this problem will in a measure solve itself.

Marketing.—The old saying "that though a man live in the middle of a forest, if he makes a better mouse-trap than another man the public will wear a footpath to his door" is well answered by "early to bed and early to rise is not worth a cuss if you don't advertise." Whilst not saying that we in Fiji can put up a better canned pineapple than the other man, I do say that we can put up just as good—but the other chap has a long lead on us, and the only way to catch up to him is for us to continue putting up a good article, and advertise and continue to advertise. This will mean entering into an extensive advertising campaign throughout Great Britain and Canada and the Continet. Now, this will mean that we will require a large amount of money, and I doubt if the Companies operating in Fiji can finance such an undertaking, though it is vitally necessary, not only to the welfare of the Companies concerned, but to the Colony as a whole, that such a campaign should be launched with as little delay as possible. I think that I am not being optimistic in estimating the possible out-put by the two Companies at present operating in Fiji will, inside 10 years, reach 2,500,000 cases. I will not go into figures, but leave it to you gentlemen to calculate the benefit that will be derived by the Colony in revenue, not to mention the cash put into circulation by such a quantity of fruit being canned in Fiji. I may state that the Empire marketing Board has only recently assisted the Colony of Mauritius to the extent of obtaining 300,000 pineapple tops from Hawaii for the purpose of assisting the people there to establish a pineapple canning industry. This cannot entail a lesser outlay than £5,000 when all costs are taken into account. The Queensland Government have lately decided to assist the export of canned pines to the extent of £20,000. These facts embolden me to suggest that the Government interest some such body as the Empire Marketing Board in assisting to finance such a scheme, such finance to be repaid by making a special levy of a certain amount per case canned.

In conclusion Mr. Riaz mentioned the fact that the Canadian market now required Certificates under the Pure Foods Ordinance 1925 and suggested that the Government should bring this Ordinance into operation forthwith.

Mr. Ricketts said that he did not agree with some of Mr. Riaz's statements regarding the cultivation of pineapples. He pinted out the fact that at Nadi it was possible to cultivate by machinery, but that at Waidau the land was fallen bush country too steep to work with ploughs and also covered with stumps, which would probably disappear in three or four

years. For these reasons the Waidau pineapples were cultivated with mattocks and shallow cultivation by making a small hole, and this method had been found most successful. One difficulty experienced at Waidau was to get a pine small enough in weight to suit the small tins required by the trade. Pines weighing up to 9 or 10 lb were grown on Ovalau and there was too much waste. The ideal pine for canning weighed about 3½ to 4½ lb.

Mr. J. L. Hunt said that he must congratulate Mr. Surridge on the very able paper which he had put before the Conference on the matter of Supplementary Crops. He remarked that if Mr. Surridge could guarantee £200 per acre return per annum there would be plenty of people anxious to come to Fiji. He himself would be very glad to know what the crop was. The important thing was not to tell growers how to grow their crops but to tell them how to market their crops and what their return would be. He did not think it wise to put an additional tax on bananas at the present time. As he had said in his paper there were practically no Europeans producing bananas at the present time, but he did not see any reason why there should not be if Europeans could be assured that bananas could be produced free of disease. Disease was the big bug-bear at the present moment and Europeans did not want to plant up bananas that would only last 12—18 months. He said that conditions had improved since the floods of 1929 and 1930 and there had been a reviving interest amongst European planters. He agreed with Major Joske that the cultivation of kumalas, Mauritius beans, maize, &c., were more suited to the Indian, Fijian and Chinese population. The big thing was to produce the crop in Fiji when the prices were highest on the market. He said that the question of grading was a very serious one. So far as the European was concerned there was no trouble if he were the producer because it was in his interests to see that the material was properly graded. The European purchaser of native fruit had to travel over large areas in order to collect the fruit and although the quantity might only be 500 cases the number of individual owners might be anything up to 50. For this reason it would be easily understood how difficult it was to grade on the packing stations. Mr. Hunt remarked that another big difficulty was the fact that the producer wanted too much for his produce. If the prices were reasonable the consumption would be larger and this would compensate the grower because he would be able to dispose of a greater quantity of produce. In conclusion he urged upon the Government to demonstrate by experiments the crops which could be grown, the cost of production and the return to be expected from them.

Mr. Pearson (Secretary for Indian Affairs) said that he would like to join with Major Joske and Mr. Hunt in congratulating the Conference on having secured from Mr. Surridge such an admirable and illuminating paper on the subject of Supplementary Crops. He felt that the paper dealt with all aspects of production, marketing, grading, &c., and he would like to have the paper sent to the Natabua Training School and to have it translated into Hindustani for circulation amongst Indian growers. He said he was particularly interested in Mr. Surridge's remarks about the cultivation of grapes for the out-of-season market. He said that he knew something about the Channel Islands and he wondered if Fiji could not be the "Channel Islands" of New Zealand and Australia for out-of-season crops. Speaking on the question of rotation of crops he was inclined to the opinion that perhaps the Indian through tradition went in for too much variety. He was much interested in what had been said about tomatoes. He came from a part of England where tomatoes were grown in large quantities.

Apart from the fruit which was sent to the market there was the question of the collection of small and green tomatoes to be made into tomato chutney and he wondered if this industry could not be established in Fiji. Mr. Pearson said with regard to beans he was interested in this matter mainly from the point of view of rice growing, and he considered that the Indian farmer required some other bean crop to grow in the off season Another point in Mr. Surridge's paper which particularly interested him was the cultivation of the egg-plant. Mr. Pearson remarked that the egg plant was a delicious thing and it seemed possible that the cultivation of this could be extended in Fiji. Speaking on the question of co-operation Mr. Pearson said that he was associated with Mr. Barnes on a Committee which had been considering ways and means of encouraging co-operation amongst Indians. They had come to the conclusion that it would be necessary to move slowly in this matter and in the first instance to encourage the Indians in the establishment of suitable crops and then gradually work in a scheme of co-operation. He remarked that the officers of the Agricultural Department were doing splendid work in assisting the Indian comunity to produce crops which would be of benefit to them and he thought that organisers or superintendents were needed to organise the marketing of the produce. He considered that it would be possible for these organisers to get in touch with the small producers and to go into matters connected with production and marketing. During the discussion last year on minor crops Mr. McGowan has supplied some very useful information in connection with the production and marketing of minor crops. Mr. Pearson said that he wondered if concentration on overseas markets was not too marked. He considered that one remedy for the present depression was concentration on the home market and production for home consumption. There was no doubt that the returns would show that the value of products imported into Fiji ran into a very considerable amount and there seemed to be no reason why some of these products could not be grown in Fiji and not only keep the money in the country by cheapen the price of the commodity. He mentioned one commodity, ghee, and said that lately the Indian settlers had become quite enthusiastic about the local product which was much superior to the imported article and also much cheaper.

Mr. Wastall said that he had great admiration for the work which the Agricultural Department had undertaken during the last few years. One thing he would like to mention was the maize-meal bread which the Department had distributed at the Show and he felt that there was no reason why we should not make the bread in Fiji instead of importing the wheat flour. He agreed with all Mr. Surridge had said and also wished to join with the previous speakers in congratulating Mr. Surridge on the excellent paper which he had presented. He maintained that Fiji would not progress until there were more European settlers. He emphasised the fact that there was plenty of room for anyone who went about it in the right way to do well on the land in Fiji. Turning to the question of beans he drew attention to the fact that rice bean was valuable in three ways, namely, cover crop, seed producer, and as an edible product. He understood that the Colonial Sugar Refining Company were at the present time using large quantities of rice bean as a cover crop and that it was being produced in Australia in place of the Mauritius bean. Nature produced about 7,000 orders of legumes of different varieties and he stressed particularly the advantages of the rice bean which produced prolifically; the crop could be picked every morning for three months and the bean was an excellent food for fowls as well as for man. There was another plant which he thought

was indigenous to Fiji and that was the Nasau. It was a Solanum and no effort seemed to have been made to cultivate it in Fiji. He knew that the plant grew very freely.

Mr. Barnes said that the discussion on the paper presented by Mr. Surridge had gone on for some considerable time and perhaps it was opportune to say a few words in order to clear up a few misapprehensions which might have arisen after the remarks of some of the speakers. He said that the object of the paper was not so much to stimulate Europeans to take up supplementary crops, but to put into a concrete form information which had been collected by the Agricultural Department, mainly by Mr. Surridge on the production and marketing of crops which were being grown to an increasing extent by Chinese and Indians in the Colony. He said that unfortunately the Chinese Consul found himself unable to contribute to the discussion, although he was present at the Conference, but he had expressed the keenest interest in this subject, and had promised to use his influence. Major Joske in the course of his remarks suggested the co-operation of the Chinese Consul and certain Departmental Heads of Governments. Mr. Barnes informed the Conference that at the present time there was the Agricultural Advisory Committee, which unfortunately had not the assistance of the Chinese Consul, but it included the Secretary for Indian Affairs, the Secretary for Native Affairs, also the Director of Education who could give much assistance in connection with the training of school children in agriculture. He thought that the idea of a Fijian Agricultural Conference was an excellent one. The opportunity was taken during the Annual Meeting of the Young Fijian Society to deliver an address on matters closely concerning Fijian agriculture. The Department of Agriculture had carried on work on the questions that had been suggested at previous Conferences and one object of the Conferences was to indicate the results of investigations. One of the difficulties which had been experienced was the securing of proper seed, but shortly it was hoped that the Department would be in a position to distribute a limited quantity of various seeds. Referring to the pineapple paper Mr. Barnes said that there appeared to be some difference of opinion, perhaps not so serious as one might think, between the people who were planting at Waidau and those planting at Nadi. It was evident that the Waidau people had been very successful in producing fruit with shallow cultivation.

Mr. Barnes read the salient points of the Paper* on the "Citrus Exports—Experimental Shipments," and said that Fiji was particularly favourably placed in regard to citrus exports because of the possibility of getting fruit of good quality on to the New Zealand market when none other was available and to Vancouver market after the New Zealand market had become weak. The system of preferences within the Empire should go still further to encourage the development of this industry. He remarked that he saw little prospect of Europeans taking any large part in the actual growing of the citrus fruits, for some time but the Agricultural Department had imported varieties of citrus and had also secured plants of varieties scattered throughout the Colony which were known to be very popular in the export market.

Mr. Barnes in rising to close the Conference said that those who had been responsible for the organising of it had been very gratified at the interest evinced in the subjects dealt with. He thought that perhaps the information which had come to light during the discussion on the Stock Industry was the most important aspect of the Conference, and points

* Published in *Agricultural Journal* No. 2 of 1931.

had arisen which would be given early attention. The present Conference had been organised on similar lines to those of the first Conference and the idea was to let the public know the results which had been achieved in the course of inquiries pursued by the Agricultural Department. He wished to make it quite clear that the Department did not seek publicity, that the object of the Conferences was not to boost the Department, but he felt that it was the duty of the Agricultural Department to take the public into its confidence from time to time and to let them know what had taken place. Speaking on the question of publicity which had been raised by at least two contributors to the discussions he thought that the question of advertising Fiji bananas and Fiji produce might well be referred to the Fiji Publicity Board. For the past 15 or 18 months he had been Chairman of that Board and the question of advertising Fiji and also its products had been very closely before the Board. He mentioned that the Board had offered a prize of £5 for the best poster advertisement of Fiji, and the poster which had won the prize had something to do with all the industries of Fiji which had been briefly touched upon, and illustrated the keen observation of the person who had designed it. Mr. Barnes said that on behalf of the organising Committee he wished to express the thanks of the Conference to His Excellency the Governor for the keen interest which he had continued to take in the Conferences and also for his presence during a number of the discussions. Thanks were also due to the Suva Municipal Council for so kindly placing the Town Hall at the disposal of the Organising Committee. He also wished to thank Mr. McHugh, the Government Printer, who had gone to considerable trouble in the preparation of papers for presentation to the Conference. In conclusion Mr. Barnes extended thanks of the Organising Committee to all those who had prepared papers for the Conference and to those who had attended the meetings and had taken part in the discussions.

Major Joske said that the thanks of the Organising Committee, consisting of Messrs. J. L. Hunt and E. Duncan and himself were due to Mr. Barnes on whose shoulders had fallen the duty of organising the Conference. He remarked that all the Organising Committee had done was to attend a meeting at Mr. Barnes' office at 2.15 p.m. one day and say, "Yes, yes, go ahead." He said that the efforts of the Agricultural Department were fully appreciated by the presence at the Conference of His Excellency the Governor. In conclusion he would move a hearty vote of thanks to Mr. Barnes and the members of his staff who had been responsible for such an interesting and instructive Conference. (Carried by acclamation).

FORESTRY IN FIJI.

By R. A. Sykes, Conservator of Forests, Fiji.

Primitive man in the tropics looks to the forest for almost all the necessaries of life which are not provided by his field crops and domestic animals. From it he obtains materials for his house and furniture, fuel, clothing, lighting, weapons, cordage, medicines, edible fruits, game and birds, and numerous other products which play a part in his daily life. Moreover the forests provide him with a large reserve of fertile land indispensable for his primitive system of agriculture.

The arrival of the white man with his civilising and developing influence at once results in a heavy drain on the forest. Large areas of forest land are cleared for agricultural development, and a demand arises for timber for constructional work, roads, railways, domestic purposes, cases for agricul-

tural products and fuel. Further, white rule, bringing with it the blessings of peace and improved hygiene, stimulates a rapid increase in the native population and proportionate increased activity in native agriculture. The consequence in some parts of the tropics is forest destruction on a grand scale at the hands of native agriculturists practising " shifting cultivation," the only system of agriculture known to them.

The most obvious effect of this drain on the forest is the increasing scarcity in accessible situations of the more valuable timber trees. This in itself may be a serious matter but there are other more subtle effects, and unfortunately these too often do not become apparent until it is too late to remedy the situation by immediate action.

It is perhaps not sufficiently well known that the forests of a country have a decisive influence on its climate, particularly in the matter of rainfall. It may be thought that this influence is negligible in a Colony such as Fiji, consisting of a number of small islands enjoying an " ocean " type of climate; but that forests cannot be destroyed with impunity even on Pacific islands may be judged from Guppy's comparison of the rainfall in Hawaii with that in Fiji. Writing of a visit to Hawaii, he says:—*

> " The consequence of unchecked destruction of the forests was in my time becoming only too evident. When I passed through Ookala on the Hamakua Coast at the end of May, 1897, there was a water famine. Water was sold at a quarter of a dollar a bucket, and the allowance for a family was three oilcans a week. . . . . Originally forests covered the upland plateaux and mountain slopes of all the islands. Now much of the original forests has been removed and large areas of naked soils and bare rocks remain. The present forest area is about 20 per cent. of the islands, a small fraction of what it was a hundred years ago. It is, however, very satisfactory to learn that American energy is combating this evil. . . . . Hawaii owes much to the United States Department of Agriculture. May we in England take the cue in the case of our own Crown Colonies ! "

Referring to the climate of Fiji he writes:—

> " Fortunately the Fijian Islands have not been long enough occupied by the whites to produce much effect on the rainfall through the destruction of the forests. A significant warning, however, has been given in the vicinity of Levuka. The woods of the hills around the town, as we learn from Mr. Horne, were cut down to prevent them from affording shelter to the unfriendly natives of the interior, the result being to reduce the number of rainy days in a few years from 256 to 149 per annum."

From the above extracts it will be appreciated that deforestation may not only cause a substantial decrease in the total precipitation of rainfall, but may also bring about a variation in its incidence. The effect of such climatic changes on agricultural operations is obvious.

The forests on mountain slopes are of value in another way. The foliage of the trees protects the ground from the mechanical disintegrating effect of heavy rain, and the forest soil below, rich in vegetable matter, acts as a sponge which absorbs the water gradually and gradually releases it. Not until this soil becomes saturated is there danger of serious flooding. A heavy downpour of rain will produce no effect more serious than a slight rise in the level of the rivers, and in periods of drought the rivers will fall gradually, drawing on the reserves of water held in the spongy soil of the

* *Observations of a Naturalist in the Pacific*, Vol. II, H. B. Guppy.

forests. Now compare the situation which occurs when a mountain has been deforested. Then every storm will be the signal for the appearance of innumerable torrents which eat out their course as they flow, often laying bare the naked rock beneath. The main river of the system may be unequal to the sudden strain, and overflowing its banks, flood the lower plains with its silt-charged waters. After the storm the flood will subside as rapidly as it began. In dry periods the river having no reserves of water to draw on may be reduced to a mere trickle or even dry up altogether. Our experiences in February are too fresh in our minds for us to underestimate the disastrous effects on agriculture of frequent and severe floods.

Part II.

The British are historically a race of forest destroyers. The forests of the Homeland have long ago practically disappeared, and in all the big Dominions and Colonies with the exception of India they have been regarded up to quite recent years either as a nuisance to be cleared away with all speed to make way for agricultural and industrial development or as an asset which no amount of exploitation can exhaust. It is a British characteristic to live in the present and let the future look after itself, with the comfortable assurance that when the inevitable crisis does come along we will " muddle through " somehow. The War gave this complacent attitude a rude shock in many directions, and among other matters focussed the attention of statesmen in all parts of the Empire on the results of the past improvident destruction of our timber assets. The need for constructive action was further emphasised by the warnings of high authorities who have been examining the World's resources and consumption of softwoods. Mr. Fraser Storey, of the Forestry Commission, London, after a statistical survey of the position, has stated that a serious shortage in the World's supply of softwoods is likely to occur in about 40 years' time. The gravity of this statement will be appreciated when it is realised that the production of a mature spruce tree may take anything from 70 to 120 years.

India has long been a shining example to the rest of the Empire of the great advantages ensuing to the community from a sound forest administration, and of recent years the Home Country, the big Dominions and the larger Crown Colonies have been taking active steps to put their forest administration on a similar basis.

It will be realised from the above remarks that forest policy has both a national and an Imperial importance. Further, it is of the nature of forestry that its returns are slow, that the individual can very rarely hope to reap what he has sown. A forest policy must have continuity over a very long period of years, more than three generations of men. Experience has shown that the task of framing and carrying out such a policy cannot safely be left to private enterprise. Governments alone have the necessary continuity and ability to take the long view, and are not so prone to the temptation to take an immediate profit at the expense of future generations.

In countries where systematic forest management has been in force for centuries, for example, France, Germany and Switzerland, the forests are a great national asset and yield a substantial nett annual revenue to the State. This is true also of India, whose forest administration dates back a mere sixty years or so.

In the early stages of forest administration, particularly if, as is almost invariably the case, the forests have been exposed for a prolonged period to uncontrolled felling, expenditure will in all probability exceed revenue for a number of years. As in any other form of production a certain amount of

capital must be invested to secure a return. It is therefore desirable that the individual citizen who pays for the service should understand the importance of a forest policy, its aims and, as far as possible, the means whereby it is to be carried out.

In a country such as Fiji, the primary objects of forest management would be as follows:—

(i) to provide a sustained annual yield of timber and fuel sufficient for all future requirements;

(ii) to maintain an area of forest sufficient to ensure an adequate rainfall, and to reduce the risks of flooding and erosion by controlling the run-off in mountainous country.

Secondary objects would be to provide catchment areas for local water supplies, and to preserve the amenities of the countryside by protecting beautiful tracts. Anyone who has seen the devastation in the neighbourhood of the Prince's Road near Suva may indeed be inclined to regard this last as of primary rather than secondary importance.

The first need of a Government embarking on a forest policy is to have control of forests or at least afforestable land. To this end permanent forest estates or forest reserves are created. In other tropical countries it has been found that reservation of 25 to 30 per cent. of the total land area is sufficient to ensure that the objects of the policy are realised. Forest reserves may be constituted on land already held by the Crown, or they may be acquired in some other manner.

The great proportion of forest land in a British Crown Colony is usually owned by the natives. In Nigeria, where the natives own their land communally, forest reserves are as a rule acquired by agreement. The natives do not part with their ownership of the land but surrender the management of it to the Government. In return a proportion of the revenue obtained from the forests is paid into native funds. Government have powers to acquire forest reserves compulsorily if it is considered necessary and if the native owners are unwilling to surrender control by agreement. It will be understood that there is difficulty in persuading a primitive people to surrender control of their land for objects which they find hard to understand and with which in any case they have little sympathy, but this antipathy will gradually disappear as the revenue from the reserves under systematic management increases, and as the forests which are not reserved are destroyed.

Selection of the reserves and their subsequent working to obtain the maximum sustained yield can only be undertaken by experts.

Part III.

My survey of the Fiji forests is not yet complete, but it may be of interest to set down some of the impressions which I have received so far. The arrival of the European has not been attended in Fiji by that wholsesale clearing of forest lands which is such a marked feature of his advent in other parts of the tropics. European development has been slow and has been more or less confined to areas of low elevation in the coastal districts. The Fijian farmer, though he is a shifting cultivator, has not made any serious inroads into the forest. His population is comparatively small and is not increasing rapidly. In fact, I received the impression in some districts that there was a tendency to migrate from the villages of the hinterland to the coast. In short the greatest destruction of forest has occurred in the lower-lying developed districts at the hands of European, Indian and Chinese settlers. Old residents have informed me that the amount of silt deposited in the channel of the lower Rewa appears to have been increasing of recent

years and there can be no doubt that this is due to increased erosion in the basin of that river consequent on intensive settlement. Elsewhere, so far as my inspection has gone, there does not appear to be any urgent present need of forest conservation with the primary object of stabilising the climate or preventing erosion. At the same time there is not, so far as I am aware, any legal machinery to check extensive deforestation at high altitudes and in view of the irremediable character and possible disastrous consequences to the agricultural community of such action, the situation requires careful watching.

Now let us consider the position from the standpoint of timber supplies.

Our imports of timber for the year 1929 (a more normal year than 1930) consisted of about 10,500 tons of softwoods and 2,000 tons of hardwoods. The out-turn of sawn timber from local mills is estimated to have been about 8,000 tons and of timber cut for other purposes including native consumption and fuel, about 50,000 tons. The total estimated consumption was thus 70,500 tons, of which our own forests provided about 58,000 tons. This reckoning does not take into account imports of wood in a manufactured form, such as furniture, paper, artificial silk, &c.

The wood consumption per caput of a community is an index of its standard of civilisation, and in a new country the increase in consumption over a period of years is also a guide to the rate of development. The present depression has no doubt slowed down consumption considerably, but when normal times return we may expect a steady expansion in the annual consumption, due to European development, increase in population and improvement in the standard of living of the native races.

Fiji is therefore faced with (1) the probability of an increasing internal demand for timber of all kinds, and (2) the prospect in the not too distant future of a shortage in the external supply, particularly of softwoods. In these circumstances it is wise to take stock of our own resources.

Fiji is fortunate in having in her forests woods suitable for almost every purpose. The following are our more important woods classified according to usage:—

Hardwoods.—Buabua, Vesi, Yasi, Sacau, Savai, Vuga.
Medium hardwoods.—Yaka, Bauvudi, Damanu, Rosawa.
Softwoods.—Kauri, Dakua Salusalu.
Casewoods.—Kauvula, Kaudamu.
Fuels.—Dogo, Nokonoko, Caukuro.
Luxury wood.—Sandalwood.

Of the hardwoods, Buabua and Vesi are the most sought after. Both have a limited range, and consumption, particularly of Buabua, probably exceeds production. Sacau and Vuga are mountain trees and not being easily accessible are not much cut. Yasi, of which there are many kinds, is in good supply over most of the forest area. Savai is in fair supply in Vanualevu, less so in Vitilevu.

Of the medium hardwoods, Yaka is at once the most sought after and appears to have the most limited range of any tree in Fiji. It does not regenerate well without assistance, and exhaustion of the more accessible stands of Yaka appears to be a matter of time. Damanu is a common tree in better quality forest throughout the group. Bauvudi, though not so common as Damanu, is in fair supply. Rosawa is rather rare and grows usually at high, not easily accessible elevations.

Of the softwoods, the Kauri has been heavily cut where reasonably accessible. It is widely distributed over the mountain ridges of the islands, and in a few localities it may furnish about 60 per cent. of the millable volume. It does not regenerate well without assistance, but the seedlings

of the tree are fairly hardy when established. Dakua Salusalu is less widely distributed than the Kauri, and is common only in a few favoured localities. It regenerates freely, but the seedlings are quickly killed by lack of light and pressure of competition. Both these trees yield a timber equal, if not superior to, any imported softwood, provided that due attention is paid to seasoning, a matter which has been too often neglected.

The casewoods, Kauvula and Kaudamu, are in good supply. There are probably other woods suitable for this trade and the yield of the forest appears to be more than equal to the present demand.

Of the fuels, Dogo has been heavily cut in the neighbourhood of Suva, and exhaustion of the big timber of the Navua forests is in sight. There is still a large reserve of smaller sized fuel in the Rewa Delta. There has not been much exploitation of the other Dogo forests. The tree regenerates well and needs little assistance. Nokonoko and Caukuro are in good supply on the dry side of the islands.

Sandalwood in commercial sizes has practically disappeared, and even young saplings are exceedingly rare. This tree furnishes one of the most valuable woods in the world. Fiji has lost a valuable asset by allowing uncontrolled exploitation of her sandalwood forests.

It is a basic principle of forestry that the annual cut should not exceed the forest's capacity of production if the yield is to be maintained. The disappearance of sandalwood is due to non-observance of this principle, and it appears that supplies in accessible situations of Yaka, Kauri, Dakua [Salusalu], Buabua and possibly Vesi are dwindling for the same reason.

The danger with a situation of this sort is that it is not apparent until an acute crisis arises when it is probably too late to take effective remedial action. It is not, for example, expected that warning of the approaching shortage of softwoods will be given by a gradual increase in the prices of these woods. The reason is that the American mills, which hold the key to the position, are planned on the basis of an enormous output. Prices are therefore likely to remain comparatively stationary for some time and rise sharply in a series of jumps as these mills are put out of action one by one owing to failure in the supply.

The forests of Fiji are quite equal under scientific management to the task of supplying indefinitely all possible future requirements, and even of providing a balance of our better class woods for export. It is not proposed to describe here in detail the methods by which this desirable end can be accomplished, but it may be briefly indicated that improvement of forest lands is effected mainly through cultural operations designed to increase the numbers of economic species in the forest rather than by clearing and planting. At the present time many of our forests are uneconomical to work on account of the low proportion in them of economic species. Improvement of such forests would present little difficulty to a professional forester.

An active policy of forest development would make productive lands which are at present practically worthless, would improve the internal communications of the Colony, and would provide a number of Europeans and natives with congenial employment. It is realised that it may not be financially possible to embark on such a policy at the present time, but this article will have served its purpose if it has brought to notice a situation which it may be dangerous to neglect.

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